POPULAR SCIENCE

FOUNDED MONTHLY 1872

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AMAZING MAGNETIC AIR LINE

Page 57

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SEE PAGE 32

AT THE TOP OF THE HILL

A LONE figure in overalls surveys the fields of his labor. Freshly planted rows point their even lines around a gently rising hill. Seemingly the world and its people are far away. But this man is not alone!

His home is at the top of the distant hill. And in his home is a telephone. Eighty-five million miles of wire lead to it. His call is a command to one or more of several hundred thousand employees. Day or night he may call, through the Bell System, any one of nearly twenty million other telephones in this country and an additional twelve million abroad.

And yet, like you, he pays but a small sum for a service that is frequently priceless in value. The presence of the telephone, ready for instant use, costs only a few cents a day. With your telephone, you are never alone. It is an investment in companionship, convenience, and security. Through it you can project your personality to the faraway places of the earth, or bring familiar voices to the friendliness of your fireside.

Undoubtedly a great factor in the continued progress and improvement of telephone service is the intangible but real spirit of service that has become a tradition in the telephone business. This spirit expresses itself daily and in any emergency. And behind the army engaged in giving service is the pioneering help of a regiment of five thousand scientists and technical men, engaged in the sole task of working for improvement.

This group devotes itself exclusively to seeking ways and means of making your telephone service constantly better and better.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

What is the
RECONSTRUCTION
Finance Corporation
Doing?

It is acting as a great discount bank, and is loaning over $7,000,000 a day

THESE loans are made to every part of the United States through commercial banks, savings banks, trust companies, joint stock land banks, Federal intermediate credit banks, agricultural credit corporations, live stock credit corporations, and to the railroads, building and loan associations, mortgage loan companies, and insurance companies.

★

The applications come in through the 33 branches and are carefully inspected locally as well as in Washington. But action is rapid, and one day's operations will take in many of the above avenues of distribution in most sections of the country.

The amounts loaned vary from a few thousand dollars to several millions, and due consideration is given the necessity of each case.

WHAT ARE THE CHANGES IN THE ECONOMIC PICTURE?

THROUGH the Reconstruction Finance Corporation, the enlarged powers of the Federal Reserve System, the campaign against hoarding, and the United Action for Employment, great fundamental changes have developed.

Beginning in the summer of 1931 with the financial crisis in Germany, followed by the suspension of gold payments in England, a tremor of fear went through the entire world. The shock manifested itself in America by enormous gold withdrawals on the part of foreign central banks which had been leaving their money on deposit with us for years. Bank failures increased rapidly in this country as a result of the financial excitement, which encouraged the hoarding of currency and the sale of securities.

This picture is now changed. Money is being returned to circulation. The resources of banks that failed in March are about equalled by the resources of the banks that reopened. People are becoming impatient with anything which is obstructing the return to normal trade and normal living. The dollar is able to buy more in merchandise, services and securities than it has for many years. The *active dollar* is the only dollar that is valuable, and it is now putting its more slothful neighbor to shame.

THE NATIONAL PUBLISHERS' ASSOCIATION

"As the most nearly self-contained nation, we have within our own boundaries the elemental factors for recovery."

(From the Recommendation of the Committee on Unemployment Plans and Suggestions of the President's Organization on Unemployment Relief)

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Popular Science Monthly for July, 1932

NEW DEVICES FOR THE HOME

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UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

CRAFTWORK

WOODWORKING

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HINTS FOR THE MECHANIC

Choosing *and* Using Tools

Hitting a hammer handle violently to draw a stubborn nail often snaps the wood in two

Using the flat side of a hammer to drive a paring chisel generally will ruin the handle

By Prof. Collins P. Bliss

Director, Popular Science Institute, Dean, College of Engineering, New York University

IN SELECTING the first hammer, primitive man searched carefully for a smooth, oval stone that would fit comfortably in the palm of his hand. Later, he found that this crude implement could be improved by roughing out shallow depressions for his fingers. Finally, rough wood and bone handles were added, with leather thongs to hold the heads.

Primitive man chose his hammer carefully after testing the rock for hardness and the handle for toughness. Today we enter a hardware store, hastily look over a group of hammers ranging in price from twenty-five cents to $2, and buy the one that suits our pocketbook or the one that bears a trademark we know. Superficially, most hammers are alike. Actually, one may outlast another many times.

Two carpenter hammers were recently sent to our laboratories to be tested, the results of these tests to be included in a report of the New York State Department of Labor. Outwardly there was very little difference between them, yet an inspection of their tags revealed that one had cost two dollars, the other, ten cents.

In our laboratories, by means of special tool testing machines, these two hammers were subjected to the equivalent of months of rigorous wear in about an hour. The handle of the two-dollar hammer failed only after seven thousand blows had been recorded on one machine, which swings the hammer as a carpenter would. But at the fifteenth blow, ten seconds after the start, the head of the ten-cent hammer was loosened from its handle and thrown across the room. As many as four hundred and sixty-six of the cheaper hammers would have been required to do the work of one hammer of the better grade —a total cost of $46.60 as compared with $2. What had appeared at first to be a bargain had proved an expensive tool. Each blow struck with the cheap hammer had cost over a half a cent.

Aside from the economy of it, the amateur owes it to himself to use tools that are safe. A cheap hammer, failing under the slightest strain, may cause serious injury to worker or bystander. Out of one hundred hand tool accidents, recently investigated, thirty were caused directly or indirectly by poorly designed or defective tools.

In selecting tools, the amateur can shift the responsibility of testing by buying tools selected by the Popular Science Institute. Every product approved by the Institute has been thoroughly tested and can be expected to give absolute satisfaction under normal and proper use.

Buying good tools is one thing. Maintaining them in good condition is another. Good tools remain good only when they are carefully used and kept in first class condition. Screw drivers should be used only for the purpose of turning screws. Hammers should be used only for driving and pulling nails. Wrenches should be used only for tightening and loosening nuts. Misuse of any tool is unsafe.

A good workman should know not only how to use his tools but how to take care of them. Take, for instance, the hammer. Small nicks or bits of hardened glue on the face of a hammer will often cause it to glance from the nailhead, bending the nail or injuring the fingers.

A well known manufacturer in New York, according to a report of the Bureau of Industrial Hygiene, measures the qualifications of prospective employees by their skill at dressing the point of a screw driver. Each applicant is given from three to six screw drivers and told to dress the blades to fit as many different sizes of machine screws.

In grinding the thin edges of chisels, plane irons, and screw drivers, the amateur is often likely, through overheating, to destroy the delicate temper of the steel. Even the heat from such a small flame as that of a match is sufficient to draw the temper of a thin-edged tool and convert the cutting edge to soft steel.

To amateurs and professionals alike, the Popular Science Institute offers this advice: Buy good tools, use them properly, and condition them frequently.

A group of tool casualties. The saw has lost several teeth, the bit has been bent, the try-square misused as a pry, the plane dropped and broken, and other tools damaged by similar abuse

FOR THE HOME OWNER

Two Booklets Contain Much of the Information You Need in Building or Modernizing a House

House Heating and Ventilating will help you to get the most from each building dollar invested in heating equipment, by advising how to plan wisely and by supplying full facts regarding equipment now available.

In this 38-page booklet will be found descriptions of the various types of heating systems, an outline of the advantages and disadvantages of each under different conditions, together with pointers as to how to select the kind most suitable for your needs. Also, instructions are given on how to get the best results with each system through proper care.

There are special chapters on heating with coal, oil and gas which contain comparative data on cost and advantages, as well as the essential facts that need to be known if you are considering the installation of an electric stoker, oil burner or gas heating system.

Automatic heat control, room heaters, humidity, ventilation and summer cooling are other subjects treated in this booklet and, throughout, are illustrations showing various types of modern equipment.

Insulation in Building Construction covers a subject that many buyers and builders of homes need to know about. Many houses are represented as being "insulated" when they are not really insulated at all.

This booklet explains in dollars and cents just what insulation does in saving heating costs, as well as providing comfort at all seasons. From the facts given, you can decide whether insulation is a worthwhile investment for you.

Detailed description is given of the various insulating materials, their comparative rating as regards efficiency in stopping heat flow, and other factors that need to be considered in selecting insulation.

One section of the booklet describes how to insulate houses that are already built and a final chapter deals with the cutting of heat loss through use of weather-stripping, calking compound, etc.

These booklets have been prepared by the engineers of Popular Science Institute. They may be had by sending 25 cents for each to Popular Science Institute, 381 Fourth Avenue, New York, N. Y.

FROM THE LIPS OF A CHILD

by ALBERT DORNE

Our Readers Say

That's All Right, but Why Be So Surprised?

I WAS looking over the January, 1927, issue of POPULAR SCIENCE MONTHLY last evening and was struck by the many things prophesied for 1927, that came to pass, if not then, at a later date. The editorial is unique in that practically everything suggested in it has been invented and is as common today as shoes. . . . and only five years! The *DO-X* is today a reality, as is the double drop frame for automobiles, the supercharged motors, higher engine speeds, vitamins, one-way glass, and a host of other things. Some time when you have a moment to spare look over that issue and compare with the present, even the advertising, and I'll bet you will enjoy the comparison.—P.C.R., Shreve, Ohio.

His Experience Answers the Cherry Tree Problem

BY BOTH theory and experience, R.D.T., I am able to prove to my own satisfaction, at least, that there *is* more strain on the limb when the boy reaches out for the desired fruit. By experience: Mine happened to be an apricot tree, instead, of a cherry tree, but that doesn't invalidate the experiment! I got as far out on the limb as possible, and the limb still held. Nice fruit just out of reach. Hooked a leg around the limb, to steady me, leaned out and reached for desired fruit. "Crack!"—limb "goes busted!" I hit the ground head foremost, with *considerable vehemence,* and saw enough new stars to have made an astronomer's reputation for life. Conclusion: If the strain had not been increased by the leaning outward, the limb wouldn't have "busted." Not wishing to hog the camera, I will not give the arithmetical solution, but will wait for someone else to take a whack at it. If no one does so, I will later. *Query* suggested by the illustration with article: If the boy fell six feet, how would the strain on the boy's back when he hit compare with the strain on the limb when it broke?—C.A.P., Monrovia, Calif.

April First Couldn't Stop This Bridge Expert

A RECENT issue of POPULAR SCIENCE MONTHLY contained a portion of a bridge hand together with a plea from "J.W.L., Easton, Pa.," for a solution. Here's how: South leads the club king for the first trick; the diamond ace for the second; then the diamond king which is trumped by North with the heart 5. North leads the club 2 and South trumps with the heart queen for the fourth trick. South then leads the heart 2 and East takes the trick with the 6. East must then lead from his queen-8 in clubs up to North's Ace-9, giving North-South two more tricks for a total of six. Believe it or not, I solved it on April first.—W.J.L., Waterbury, Conn.

That Steam Wheel Raises a Problem in His Mind

IN CONNECTION with an article in a recent issue describing the proposed steam wheel: I note that the inventors are experimenting with a wheel operating on the end of a centrally-fixed arm. This seems all right for the one wheel but I am wondering how they expect to get synchronism on two, four, or more wheels. If pressure fluctuates even slightly, due to difference in lengths of steam lines, cooling surfaces, different packing, etc., then all I can see is ruined rubber tires. Seems more logical to mount two wheels, one in back of the other, and run them at the same time.—E.A.D., Brooklyn, N. Y.

Here's a Real Chance for You Gravitation Fans

GALILEO, to disprove Aristotle's contention that the speed of a falling body is proportionate to its mass, dropped from the tower of Pisa a small ball and a large ball. "The multitude saw the balls start together, fall together, and strike the ground together." Gravitation imparts to all bodies equal acceleration. Thus in a vacuum a lead ball and a feather, for example, fall at the same speed; but in air the lead ball falls much faster because of the greater air resistance offered to the feather. Now, if the balls used by Galileo had the same density but different volumes, it seems to me that the larger and heavier ball should have struck the ground first. To explain why I think so, consider two balls—one one inch in diameter, the other ten inches in diameter. By calculation I find that the ratio of surface area to volume is ten times greater for the small ball than for the large one. Therefore, if the two balls be dropped simultaneously from a height, will not the larger and heavier ball strike the ground first because of the greater air resistance offered to the small ball by reason of its relatively greater surface area? I believe it would, but I have had several arguments about this and in nearly every instance Galileo's experiment is cited as proof that I am wrong. Perhaps in Galileo's demonstration the difference in the falling speed of the two balls was so small that the balls *appeared* to strike the ground together. Will someone please submit a formula by means of which the speed of a body falling in air can be calculated?—A.J.P., Cement City, Michigan.

New Ideas for Driving U. S. Superliners

YOUR article in a recent issue concerning the proposed new super-liner for the U. S. Lines is very interesting, but I note that the plans call for the usual high pressure type steam power plant. It seems to me that in an effort to overcome the present speed record fuel costs and dead weight would be tremendous factors, and with an investment of that class every effort for efficiency and comfort of passengers would be considered. Have the marine designers or engineers overlooked the Emmet mercury vapor turbines? It seems to me that the savings in fuel would permit wider cruising range and larger pay loads.—N.B.C., Salt Lake City, Utah.

Thank You, Ma'am; We Do Indeed Appreciate Your Pleasant Screed

IF YOU aren't addle-headed by all this advice as to what to publish, it will be a surprise to me, but still I've got to put in my oar to say that it seems to me you cater mostly to men and boys while we women ought to have our say. Our needs are fully met in the household invention pages but we have other tastes. So for pity's sake admit no fiction. We want facts. Also cut out most of the technicalities of mechanics, chemistry, radios and airplanes. Give us more evolution, biology, anthropology, discoveries, facts about tracking wild animals, and adventures in the far parts of the earth. Give us the big accomplishments of men whose achievements thrill. Technicalities do not interest us. Your magazine should be devoted to a public that demands results, not experiments.—F.A.S., Darien, Wis.

It Turns Out to Be a Right Hefty Fox

SAY, I'd travel ten miles to see that fox that A.H. writes about. The problem itself is mere primary arithmetic, but the results are somewhat striking. For conciseness, let us say that since the weight of heaviest man is 150 pounds and of the lightest man 120 pounds, then according to the balancing condition, it is plain that 120 is to 150 as 150 is to 120 plus the weight of the fox. This gives the combined weight of the lighter man and the fox as 187½ pounds. The fox then weighs 67½ pounds. Some fox, I'll say!—C.A., Monrovia, Calif.

Even a Prince Can Read Our Magazine with Profit

STUDYING a recently published picture of Prince Lennart of Sweden, I saw that he was carrying a copy of POPULAR SCIENCE MONTHLY. This photo has added interest as it is of the grandson of a famous monarch who is also a great scientist. All of which goes to prove the wide field your magazine covers in race, language, and social position. I might also say that when I buy your magazine, I know that the advertisements it contains are to be relied upon as well as being an education in themselves. If some of your readers

who are constantly kicking will take a year's issue and classify all the articles contained in them, they will find that everyone gets a fair share.—H.C.J., Montreal, Can.

Will You Astronomers Please Get Interested in This?

WOULD you be so kind as to publish in "Our Readers Say" the following: I maintain that the sun and the moon are not stars or planets. The sun is merely the centrifugal force or vacuum that holds the planets and stars in their places. The light and heat of the sun are only chemical processes brought about by the attraction of the centrifugal force of what we call the sun whose rays are communicated to the entire universe and which are the origin of electricity. This centrifugal force or sun has been brought about by the falling or displacement of matter in space. The moon is not a satellite of the earth but merely its guide and some sort of barometer, and has no physical influence whatever on the earth. Once the earth was in the position of Neptune and one day it will be in the position of Mercury. Each planet succeeds the other in life and position and attraction. There are two currents of electricity or magnetism. One, negative, produced by the speed and rotation of planets; the other, positive, produced by the centrifugal force of the sun in attracting gas. My idea in asking you to publish this is to attract the attention of some astronomers and get them interested in the matter. —E.J.R.R., New York, N. Y.

Mile-a-Minute Bobsled Has Him Excited

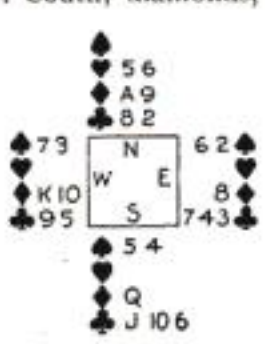
WE READ your article "Mile-a-Minute on a Bobsled" and liked it very much. We depend upon POPULAR SCIENCE MONTHLY as an authority on all subjects. There is one thing you can do for us now and that is publish an article telling us how to build a bobsled like those that were used in the Olympic Games.—B.D., Uniontown, Pa.

That "Go" on Red Idea Failed to Make a Hit

WELL of all the dumb-bell ideas! That suggestion of E.A.T.'s that traffic lights should be reversed, so red will mean go and green will mean stop, takes the cake! Maybe psychologists tell you red is an irritating color that makes drivers want to plow ahead. But common sense tells you red is and always has been the universal signal for "danger." If people would quit trying to tinker with the traffic lights and pay more attention to them, there would be fewer accidents.—B.R., St. Louis, Mo.

Proud of Your Bridge? Then Try This One

IF YOU had trouble with that bridge problem of yours, J.W.L., keep yourself awake a few nights with this one: South, diamonds, queen; spades, 5, 4; clubs, jack, 10, 6. West, diamonds, king, 10; spades, 7, 3; clubs, 9, 5. North, diamonds, ace, 9; clubs, 8, 2; hearts, 5, 6. East, diamonds, 8; spades, 6, 2; clubs, 7, 4, 3. Hearts are trumps. South leads and is required to take all tricks. Try that on your saxophone, Old Timer, and let me know how you get along.—A.H., Forest Hills, L. I., N. Y.



He Believes Progress Is the Thing That Counts

I AM quite confused when it comes to evolution or biotrophy or whatever you wish to call it. My faith leads me to believe that man was created as man and monkey as monkey. But on the other hand, man and monkey and everything else were created in order to develop, to make progress. And evolution is progress, isn't it? How about some help on this, you evolution sharps?—M.Y.M., Washington, D. C.

After All These Long Years, Astrology Gets a Boost

ASTROLOGY originated in Thebes (Egypt) centuries ago. It remained for ages a secret science in the East. Its public application in the West originated since Varaha Muhira published his book a little over 1,400 years ago. If it fell into disrepute it was due to those who wanted to make money by means of a system entirely based upon mathematical instead of transcendental metaphysics, as the Key of Astrology is lost to modern Astrology. Some of the greatest minds of the ages were firm believers in Astrology, or that the stars had a great influence on mankind. Plato, Hippocrates, Paracelsus, Kepler, Sir Isaac Newton, Bishops Jermy and Hall, Archbishop Usher, Dryden, Flamsteed, Milton and a host of others. As one has said: "Now that photography has revealed to us the chemical influence of the sidereal system by fixing on the sensitized plate of the camera milliards of stars and planets that had hitherto baffled the efforts of the most powerful telescope to discover them, it becomes easier to understand that our solar system can at birth influence his brain, virgin of any impression—in a definite manner and according to the presence on the zenith of such or other zodiacal constellation."—H.T.S., Wausau, Wis.

Pleasant to Hear and Maybe He's Right

AS A subscriber to your magazine for the past four years, I wish to express my appreciation of it. It is written in an intelligible way and the facts stand out so that they are easily remembered. It is invaluable in keeping one up-to-date on the progress of science.—G.W.F., Vancouver, B. C., Canada.

It's Torque That Helps Your Screw Driver

IN ANSWERING C.B.W. let me say: A long-bladed screw driver turns a screw better than a short-bladed one because of torque, at least up to a certain point. The force on the handle has a longer space in which to wind up, so to speak, on the long blade. Another factor lies in the fact that the short screw driver has a small handle and not so firm a grip can be secured on it. I think this last reason is the real secret of the matter.—H.K., Germantown, Ohio.

How Deep Is This Pool with a Reed Growing in It?

HERE is a problem that G. B. of Portland, Ore., might like to try his hand at. Others can try it, too, if they like. A circular pool in a garden is ten feet in diameter. A reed grows in the center and its length is such that when it is perpendicular the tip is just one foot above the water level, and when it is pulled over, the tip just touches the rim of the pool at the water level. How deep is the pool?—D.S.R., Utica, Mich.

You Fishermen Can Try This on Your Scales

IN POPULAR SCIENCE MONTHLY I always read first what "Our Readers Say," and I can't help writing you about some of the Bozos who are always asking for new sections on this or that. You would think they were paying for the Encyclopedia Britannica. What's the use! Answer this one, some of you fishermen: Does a fish weigh less in the water or out, assuming that when out of the water the fish's "blimp" is broken? Does the air or gas in its bladder weigh anything? Also suppose you took two fish weighing exactly the same out of the water at the same time. One you kill and the other you let die of suffocation. Would there be any difference in weight? That is, would the fish you killed weigh more or less than the one that you let die? I have been a regular reader for a long time. Keep your head up. You have a right to, as your magazine is head and shoulders above the others that try to be like it.—L.W.R., Monroe, Mich.

Clean Motor Pays and This Car Owner Can Prove It

AFTER reading Martin Bunn's article, "Why Cleanliness Pays on Chassis and Motor," in a recent issue of POPULAR SCIENCE MONTHLY, I felt I must write you a personal note of thanks. I thought I was the only person in the world who cared what his or her car looked like under the hood. Everyone pokes fun at me and seems to think that a clean motor makes no difference at all in the way a car performs. Now at last I have an unknown and disinterested person to back me up with a clear and convincing article. I am glad to have someone agree with me who doesn't know me and my old maid ideas about cleanliness. The general opinion seems to be if the outside looks all right, never mind the rest. It's nice to have someone say I'm right when every one else laughs at me. —D.B., Bridgeport, Conn.

Our Merry Knockers Give This Reader a Pain

PLEASE publish POPULAR SCIENCE MONTHLY in the future as you have in the past. It suits me to a T. Knockers give me a pain. There are perhaps some articles that don't interest me much but there may be others who like them and I for one am willing to share with my fellow readers.—W.T.C., Muskogee, Okla.

That'll Teach You—When You Want to Know, Ask Us

I WISH to inform you that I have received the information for which I wrote to POPULAR SCIENCE MONTHLY and thank you for your kindness. I also wish to tell you that I wrote to the Department of Commerce, Washington, D. C., for the same information and in reply was told that the department was unable to look up same for me as they were short in their clerical force. I believe it was a very poor excuse. When I appealed to your magazine I was given the information cheerfully. Looks bad on the side of Uncle Sam, doesn't it?—J.J.D., Poquemock Bridge, Conn.

Real Gems Made by Chemist

Nature's Process of Reducing Carbon to a Pure State to Form Diamonds Is No Longer a Complete Mystery and Dr. Ralph H. McKee, Columbia's Professor of Chemical Engineering, Has Succeeded in Making Genuine Jewels of Fair Size in His Laboratory as Told on Page 16

POPULAR SCIENCE
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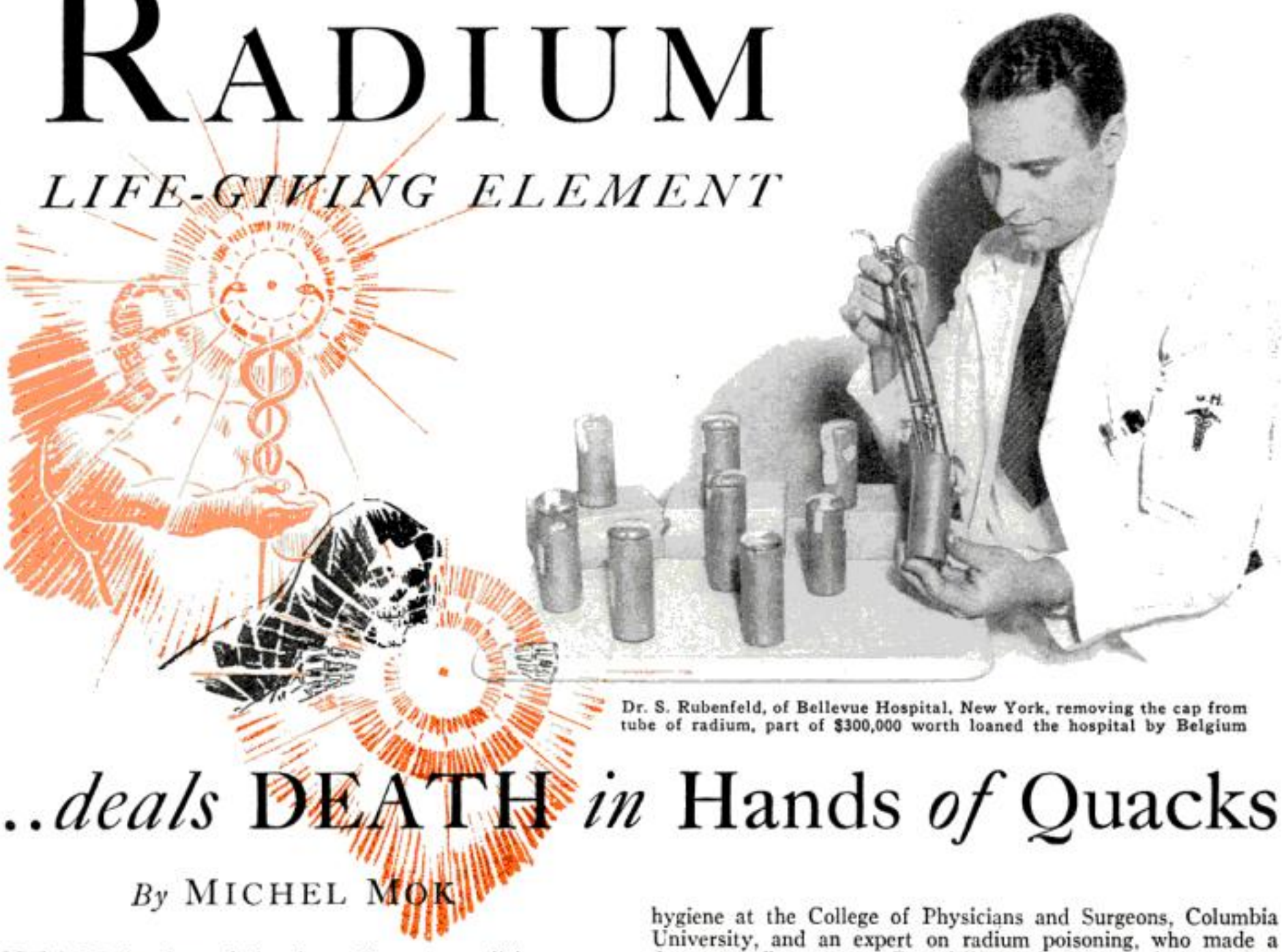
RAYMOND J. BROWN, *Editor*

RADIUM

LIFE-GIVING ELEMENT



Dr. S. Rubenfeld, of Bellevue Hospital, New York, removing the cap from tube of radium, part of $300,000 worth loaned the hospital by Belgium

...*deals* DEATH *in* Hands *of* Quacks

By MICHEL MOK

WAR has been declared on all patent medicines containing radium. The Federal Trade Commission, the U. S. Food and Drug Administration, state and municipal health agencies, and medical associations are fighting to drive from the market nostrums whose supposed healing properties are credited to radium. Life-giving when administered by experts, death-dealing in the hands of laymen and quacks, radium is the last thing in the world that should be sold over the drug store counter like cough drops or castor oil.

The opening gun in the campaign was fired the other day when Government officers in Buffalo, N. Y., seized a shipment of 1,670 bottles of a Canadian radium "tonic" intended for distribution in this country by an Ohio firm.

The recent death from radium poisoning of Eben M. Byers, Pittsburgh iron master, sportsman, and former national amateur golf champion, roused the authorities to action. For two years, Byers drank large quantities of a patented brand of radium water, a solution of radium salts advertised as a "harmless cure" for no less than 160 ailments and as a means of rejuvenation.

At first, the stuff worked like a charm. Byers, a man past middle age, was temporarily restored to glowing health. He believed he had discovered the fountain of youth, and sent cases of the radium water to his friends. But after some months, he fell gravely ill. A few weeks ago, he died in New York City from decay of the bones of both jaws, anemia, and a brain abscess.

According to Dr. Frederick B. Flinn, director of industrial hygiene at the College of Physicians and Surgeons, Columbia University, and an expert on radium poisoning, who made a desperate effort to save Byers' life, at least one other man has died as a result of drinking radium water, and many more are doomed to die from the same cause.

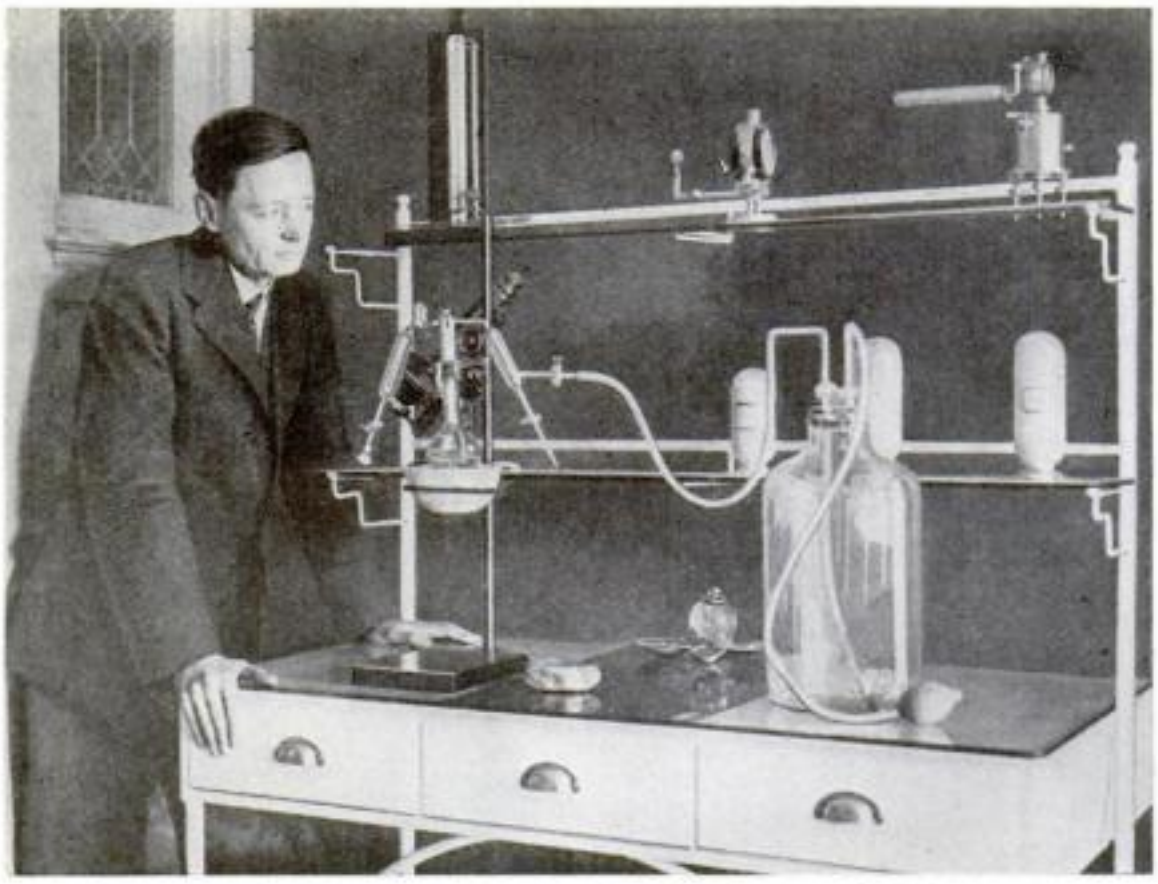
Byers' body contained the largest amount of radium ever found in a human being—more than thirty micrograms, enough to kill three men. One microgram is one millionth of a gram, and it takes more than twenty-eight grams to make one ounce.

You will understand how infinitesimal a quantity ten micrograms is when you realize that a grain of sand weighs about one milligram, or one thousandth of a gram. If this sand grain were split up into one hundred particles, each one would be the size of a lethal dose of radium. And such a microscopic speck need not be located in one spot to kill its victim. Distributed over the entire skeleton, it will produce a horrible, lingering death years after it has been taken into the body!

A terrifying illustration of radium's malignant power was the tragic fate of the New Jersey girls who were crippled and killed by radium poisoning contracted while painting luminous watch dials a few years ago (P.S.M., July '29, p. 17). Dr. Harrison S. Martland, chief medical examiner of Essex County, N. J., who made a thorough study of those cases, stated recently that eighteen former employees of the U. S. Radium Corporation plant at Orange, N. J., now closed, have died, and some thirty more probably will be crippled. Most of them got the poison into their system by pointing their radium-paint brushes with the lips.

The campaign to combat quack radium cure-alls is not directed

Startling Facts Disclosed in This Article Will Help You Escape the Dangers You Run When Ignorance Handles Nature's Strangest Element



Radon gas, rising from a solution of radium bromide, is purified in the retort and forced into tiny tubes that are cut and sealed and used in treating cancer

against the use of radium by competent physicians. Radium, as everyone knows, has proved highly effective in the treatment of certain forms of cancer. Ten percent of all cancer patients in the United States, the head of one of the largest cancer clinics in this country told me the other day, now are cured by the radium method, and the sufferings of many more are greatly alleviated.

Since the memorable day in December, 1898, when Pierre and Marie Curie discovered radium in their laboratory on the outskirts of Paris, the element has been hailed as one of the greatest blessings ever received by humanity. It was not until 1925, when a chemist named Demenitroux, a former laboratory assistant of the Curies, died in agony as a result of years of exposure to radioactive substances, that its power for evil began to be understood.

Today, scientists know only too well that radium is a Jekyll-and-Hyde among the elements. It kills as readily as it cures, and specialists handling it take the utmost precautions to protect their patients and themselves from its destructive force.

Strangest and most potent substance known to man, radium embodies the secret of the transmutation of elements, but its transmutation is in reverse, for it becomes less precious as time passes. It is a product of disintegration in a series of elements beginning with uranium and ending, after millions of years, with lead. It loses half its strength and half its weight in 1,730 years, and almost all of its potency in about 19,000 years.

BY CALCULATING the exact time it takes uranium, the parent element of radium, to turn into lead, and determining the relative quantities of uranium and lead found in various rock layers, geologists have been able to estimate the age of the earth, which now is placed at between two and three billion years. This method of reckoning is known as the "radium clock" (P.S.M., June '31, p. 18).

In its constant, mysterious disintegration process, radium emits alpha, beta, and gamma rays. Alpha rays are positively charged nuclei of helium atoms, traveling at a rate of 18,000 miles a second. Beta, consisting of negative electrons, resemble the cathode rays produced with special vacuum tubes in the laboratory. They are ejected at a velocity ranging from 60,000 to 180,000 miles a second. Unlike the alpha and beta, which are streams of minute material particles, gamma are high-frequency vibrations, similar to those of an X-ray tube, though of shorter wave length, and traveling at the speed of light.

Alpha rays have slight penetrating power and travel only about one twenty-sixth of an inch from their source. Beta may penetrate approximately sixty inches. Gamma are 100 times more penetrating than beta rays.

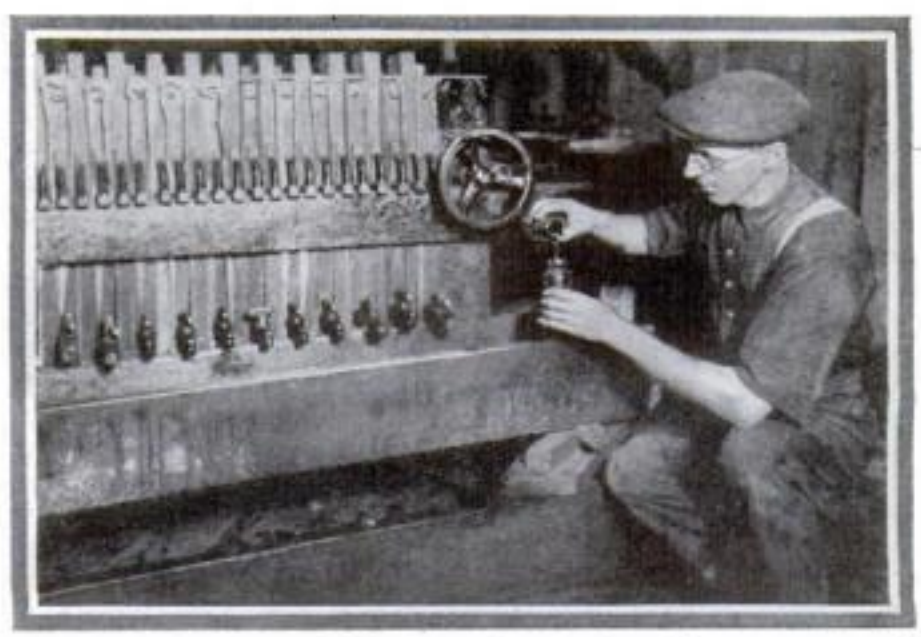
The secret of radium's dual nature lies in the widely differing effects of those three rays on living tissues. Alpha are the malignant rays, probably the most destructive known to science. Beta, also highly dangerous, cause "radium burns." Gamma are beneficent, and are the *only radium rays now used medically.*

Even gamma rays *cure because they kill*—applied in cancer cases, they destroy or arrest the growth of the cells of malignant tumors. Properly directed, they will not hinder the growth of normal body cells. Dr. Joseph Muir, of New York City, expert on radium treatment, told me that gamma rays, however, have a tendency to attack egg cells and sperm cells.

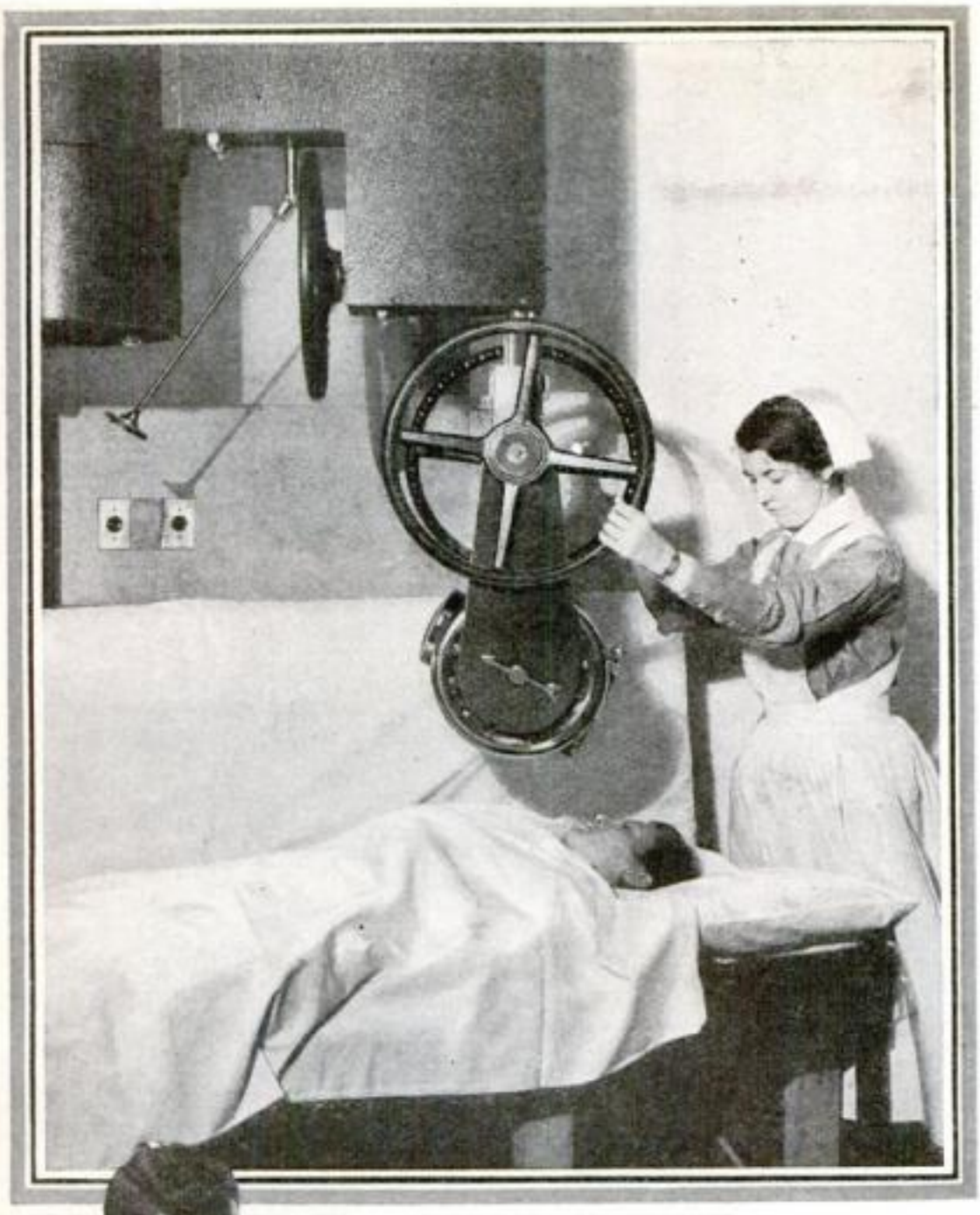
The tremendous danger in the handling of radium by laymen or in taking it in drinks or other preparations lies in the fact that the highly destructive alpha rays constitute ninety-two percent of all rays given off by radium!

Not only are alpha rays murderous; they are treacherous. After one swallows radium, it eventually is deposited in the bones. Even when taken in solution, the blood, by some mysterious chemical process, changes it back into an insoluble radioactive material, and it gets into the bone structure in this form. While the alpha rays have little penetrating power, the distance to the blood producing centers, located in the

Extracted from pitchblende in the form of radium sulphide, the metal is dissolved in these pots, after which it is ready for the final filtering

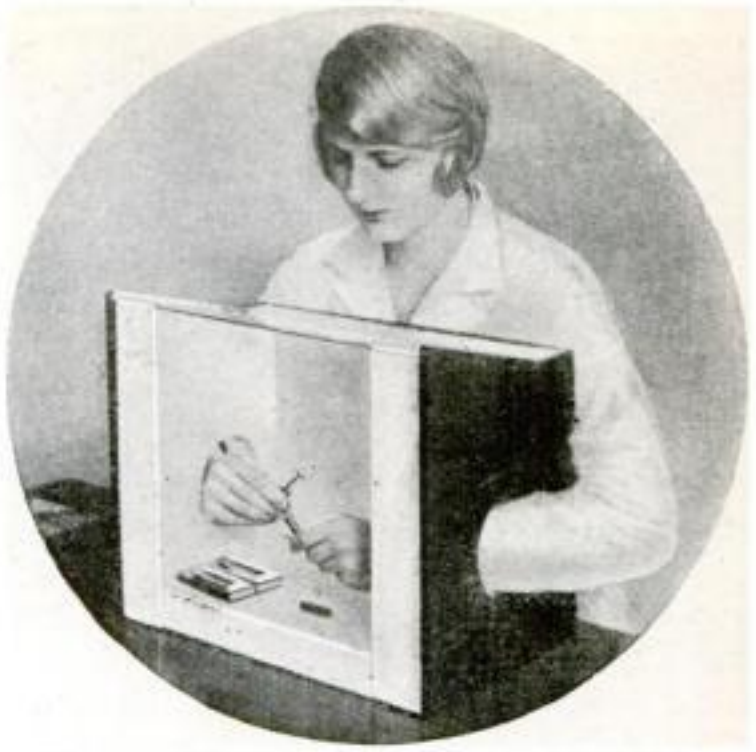


The dissolved radium sulphide is run through these filters to remove all impurities. The next step yields radium salts, the form in which it is used



In this lead-lined room, cancer patients are treated with the "radium bomb," the new instrument to administer the rays

Photo top of page ten shows the collection of radon gas. Here the tiny tubes in which gas is gathered are cut into "seeds" that are tinier than a grain of wheat



Wearing rubber gloves and her body protected by a lead-lined case, this hospital attendant is preparing radium salts for use in treating a cancer patient

marrow of the bones, is so short that the rays can reach them.

Here is where the alpha rays show their insidious nature. At first they stimulate the blood making centers, which produce more red and white corpuscles than normally. Result—the victim feels fine, "pepped up," rejuvenated.

Sooner or later, a reaction sets in—the New Jersey girls, who swallowed radioactive paint in tiny amounts, did not show distressing symptoms until they had worked in the radium plant from one to four years. The constant bombardment of alpha particles slowly wears down the blood-producing centers. Reduction in the number of white corpuscles and imperfect formation of the red cells result, and anemia develops.

Ten micrograms of radium—the lethal dose—each second eject about 370,000 alpha particles at a speed of 18,000 miles per second! Every moment of the day and night, for weeks, months, years, this barrage of submicroscopic bullets continues. Under the merciless impact, the bones themselves, particularly in parts of the skeleton subject to weight or pressure, begin to break down and finally slough off. This is called necrosis.

As radium loses half its strength in 1,730 years, the alpha-ray bombardment keeps up with undiminished fury centuries after death. Thus the skeleton of a man who, for example, died this year from poisoning by ten micrograms of radium, will give off 370,000 electrical particles per second. By the year 3,662, the radiations will be 185,000 per second.

That this is not mere theory was shown not long ago in a grisly experiment. Dr. Alexander O. Gettler, poison expert for the City of New York, examined the skeleton of one of the New Jersey radium victims, exhumed five years after death. One-quarter ounce of bone from this skeleton was held before a Geiger counter, a device that changes radium radiation into electrical impulses. By means of a loudspeaker attached to the apparatus, the impulses were amplified and converted into audible waves!

While the instrument emitted a continuous, static-like shriek, a neon bulb flashed a red light as each electrical alpha particle passed through the diaphragm of the counter. Previously, part of this skeleton's foot, placed upon a photographic plate in a darkroom and left there for a few days, had photographed itself. As this is written, preparations are being made to repeat these experiments in the case of Byers.

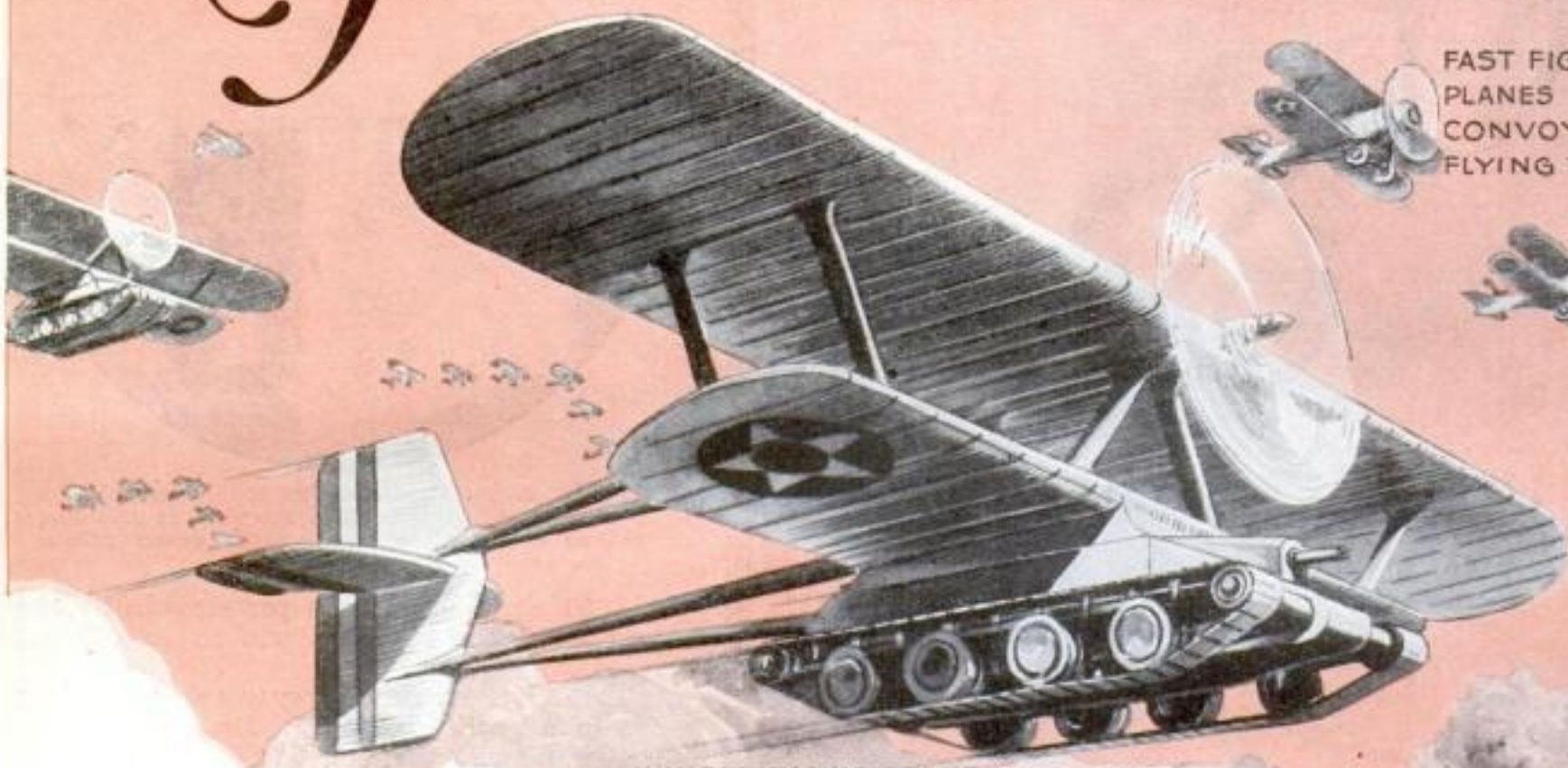
Victims of radium poisoning, however, need not die to be visibly radioactive. Those who, some years ago, were moved by the grievous plight of the dial painters, will remember the experience of one of them, Mrs. Edna Hussman, of Hillside, N. J. Arising one night in her pitch dark bedroom to take medicine, this young woman saw the mirror reflect an unearthly light that radiated from her body! It was this gruesome incident that confirmed the suspicions of physicians treating the unfortunate women that they were dealing with cases of radium poisoning.

BOTTLED artificial waters, supposed to contain radon, a heavy gas which radium gives off after it has emitted its alpha rays, have been on the market for some years, as well as "activators" or "emanators" by means of which, their manufacturers claim, ordinary spigot water can be made radioactive "while you wait." No less than 150,000 of these little machines were sold in one recent year on the Pacific Coast, and they received a great deal of free advertising following Byers' death, when the Mayor of New York City announced he had used one for years with good results. According to Dr. Martland, any benefit these emanators seem to confer on the user is due wholly to auto-suggestion. So much of the gas escapes into the air in the process, he explains, that only the stomach of a whale could accommodate the quantities of "radioactive" water necessary to produce any effect. This, he adds, also applies to radon water in bottles.

Recently, something new in radium concoctions appeared on the market—a brand of chocolate candy containing radium. Made in Germany, it is advertised as a "rejuvenator" and as a cure for most of the ills of mankind. A regular diet of this delicacy, experts told me, is certain to decrease the user's desirability as an insurance risk.

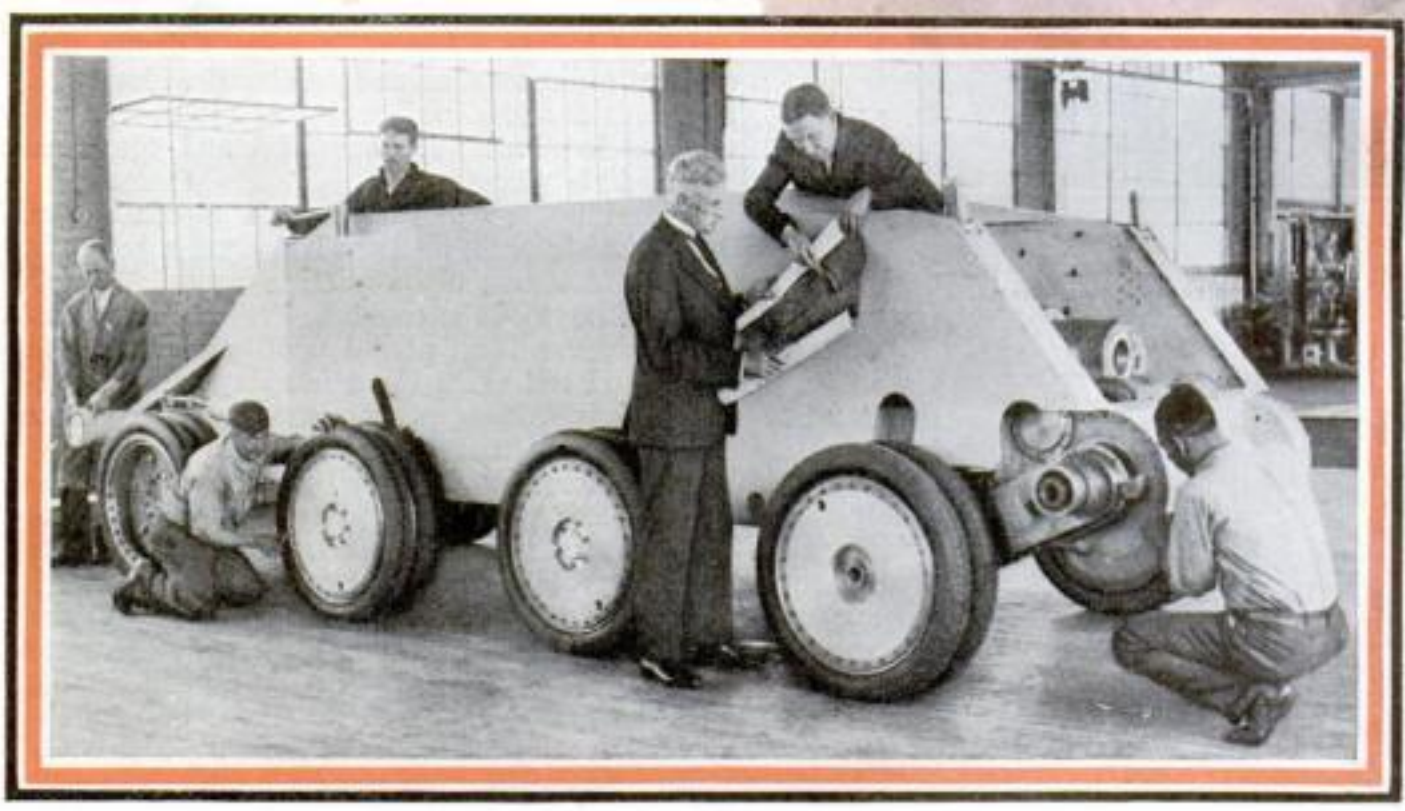
If any radioactive "medicine," whether liquid or solid, is recommended to you, and you feel tempted to try it, remember this: *No competent physician ever* *(Continued on page 105)*

FLYING TANKS



FAST FIGHTING PLANES FORM CONVOY FOR FLYING TANKS

WINGED TANKS SPEED INTO ACTION IN FLYING FORMATION



Side view of the flying tank in course of construction at Linden, N. J. Note the undercarriage is armored

A BATTLE is raging. What seems to be a fleet of attacking airplanes is sighted. Suddenly terror descends out of the sky. Swooping low, the machines are revealed to be armored tanks with wings. They land. The wings drop off, and into action roars a squadron of four-ton tanks, spitting death from three-inch guns.

That is the picture proposed by J. Walter Christie, inventor of what is perhaps the most terrifying war weapon ever conceived—a flying tank. No nightmare of mere fancy is this creation, though its inspiration might have come straight from the pages of one of Jules Verne's romances. The first of these amazing machines was taking shape in a Linden, N. J., factory as this issue of the magazine went to press. To the few who have been permitted to see it, the inventor declared that he would shortly demonstrate his aerial wonder in action.

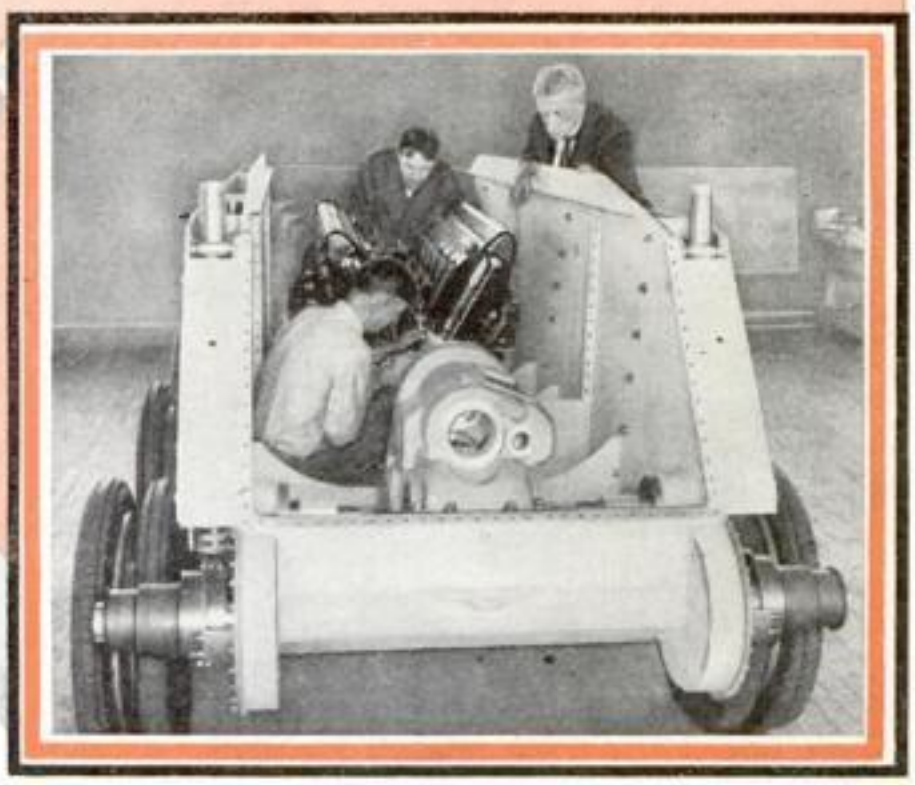
Even those who might ordinarily consider the idea of a flying tank fantastic hesitate to express doubts of its success in view of the designer's standing. Famous as an automobile racing driver of a quarter-century ago, Christie has become equally noted as an inventor in the field of automotive engineering. It was he who pioneered in perfecting the front-wheel drive for automobiles. He has repeatedly designed successful war tanks for the United States Army, which has purchased and is using a number of them in its motorized branch—notably a remarkable tank with a detachable tread and rubber-tired wheels enabling it to speed at 100 miles an hour on a smooth highway, demonstrated last year. It is around this successful machine that he has designed his flying tank.

Skillful design has pared the weight of the hybrid vehicle to a little more than four tons—less than the weight of many standard airplanes—without sacrificing the armor protection. A single 1,000-horsepower motor

Trench Warfare Doomed by Tanks That Fly

So bold that it staggers the imagination is the flying war tank which is described in this article. Revolutionary in nature, it may change the whole system of warfare and do away with the trench. Nothing like it exists at present anywhere in the world. It was conceived by a clear-headed engineer who has cut the weight of the ponderous machine until it should be able to get into the air. If the tank is a success, Mr. Christie has said he will present it to the United States Government.

...War's Deadliest Weapon



Inside the flying tank. Note 1,000-horsepower motor to drive propeller, wheels, and tread

WHEN ARMORED TANKS DROP OUT OF THE AIR

Our artist's conception of the flying tank in action. This amazing war weapon has been fully designed and one is so near completion that demonstration is expected soon

Drawing by
B. G. SEIELSTAD

HUNDRED-MILE-AN-HOUR LAND TANK

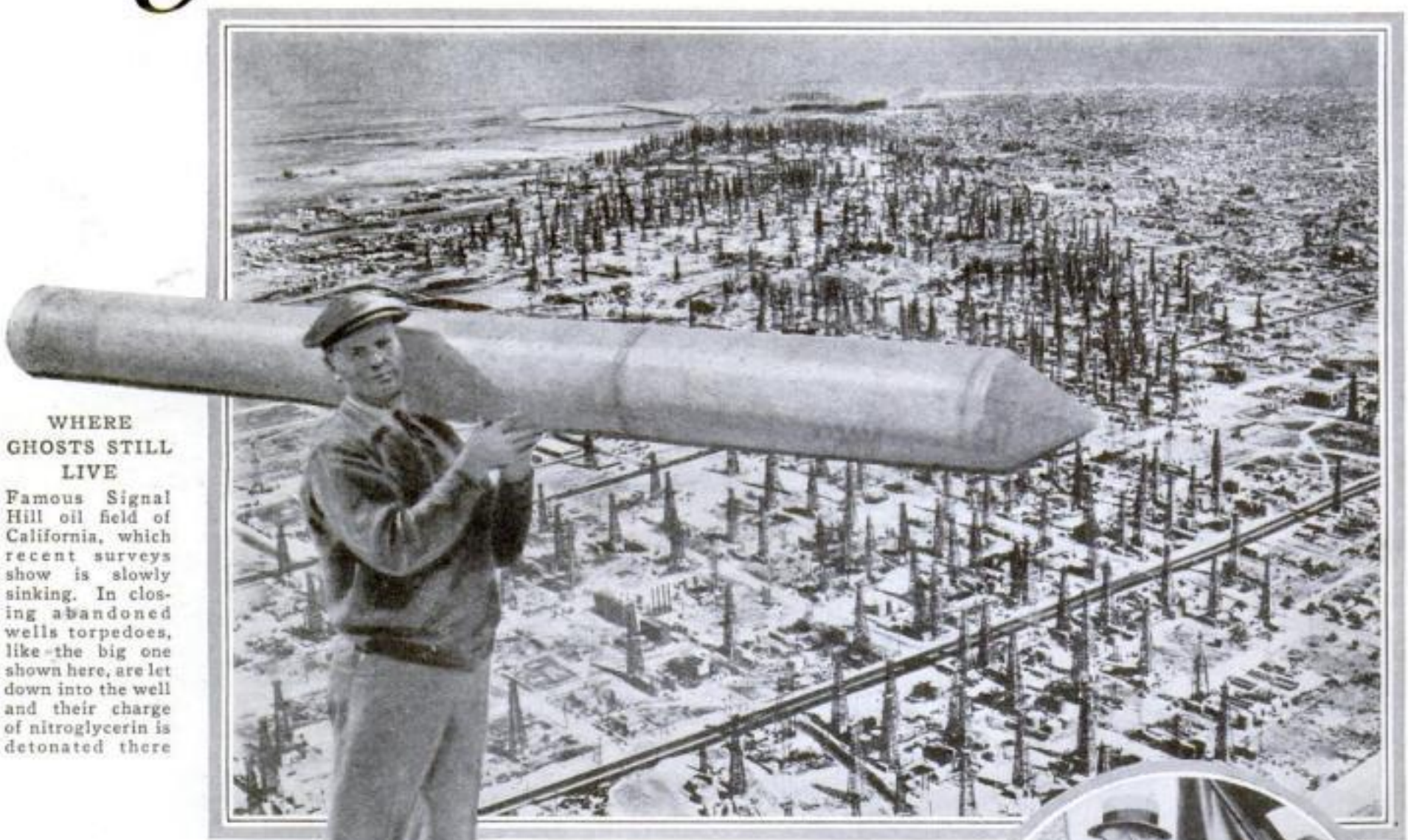
This fast land tank was designed last year by J. Walter Christie for the U. S. Army and has a speed of 100 miles an hour. Like it, the flying tank will be equipped with detachable tractor treads

drives the air propeller, the wheels, and the tread. Two men constitute the crew. When the pilot lands, he starts the endless tread whirling so that he can come to earth at high speed. Pulling a single lever discards the entire wing structure.

For future development Christie plans a different machine. Instead of a tank with detachable wings, he proposes a detachable airplane, with its own pilot, that could carry a tank to a scene of combat, deposit it while skimming the earth, and return for more tanks without stopping to land.

Military experts foresee that success of the new weapon would render trench warfare obsolete. Hitherto planes have been unable to transport an effective battle force behind an enemy's lines. But with a fleet of winged tanks, a frontal attack no longer would be necessary. There would be no way of stopping a fleet of these formidable engines of war from sailing over the front lines, landing behind the enemy trenches, and turning to charge upon the enemy's rear. Heavy guns capable of stopping the onslaught could not be reversed and pointed rearward in time to be of any real use.

Haunted Oil Fields



WHERE GHOSTS STILL LIVE

Famous Signal Hill oil field of California, which recent surveys show is slowly sinking. In closing abandoned wells torpedoes, like the big one shown here, are let down into the well and their charge of nitroglycerin is detonated there

IN THE graveyard of the oil industry, strange sounds are heard. Deep rumblings, dismal groans. Dead oil wells are turning over in their graves. Geologists, holding autopsies, have pronounced some of them not yet officially dead. Many oil fields today are haunted by these restless ghosts that rise from their tombs to create new puzzles for oil men.

Recently a citizen of Los Angeles planned to build a house. Upon a corner of the lot was a slight depression about ten feet across—the site of a long-abandoned oil well. Construction was about to start, when one morning a terrific blast awoke the neighborhood. With a mighty roar, a column of mud and water shot skyward to a height of 150 feet, propelled by a tremendous head of natural gas.

For four days it rained mud in that neighborhood, until finally the pressure dwindled and the "dead" well subsided once more. Had this strange eruption occurred after the house had been built, the structure doubtless would have been demolished and the occupants killed.

On the slope of the famous Signal Hill, near Long Beach, Calif., a large water main recently broke in a most peculiar manner. Engineers sent to investigate found the heavy thirty-inch pipe fractured sharply along its length for several feet. Soon a similar break occurred four blocks away. Higher up on the hill, another pipe cracked clear through, as if sheared by a powerful knife.

While surveying a location upon the top of Signal Hill, engineers found unaccountable errors in their measurements. Surveys were checked and rechecked. When at last a suspicion of the truth led engineers to plot contour lines on all sides of the hill, it was discovered that the bench marks set up by surveyors only five years ago are now in error.

At the summit, the altitude was found to have dropped six inches since the previous survey. Engineers of the United States Coast and Geodetic Survey are now taking measurements to determine how much the altitude has dropped since early bench marks were located many years ago.

ALTHOUGH the strange phenomenon has precipitated a controversy among geologists, Fred Hogue, formerly city engineer of Signal Hill, believes the explanation simple. Since the immense mound became pincushioned with oil wells, nearly 500,000,000 barrels of oil have been removed. Along with this have come billions of cubic feet of natural gas, whole rivers of water, and uncounted tons of sand and mud.

A vast flat not far away has been built up from the mud hauled from drilling wells. Since the huge colony of wells has virtually eaten the heart out of the hill, the ancient landmark, where Indians once built their signal fires, is gradually settling by its own weight.

Does the removal of enormous quantities of oil, gas, and sand so weaken the earth's crust that large oil fields may steadily sink throughout their old age? Geologists disagree. Most of them say that salt water fills up the cavities left when the oil is exhausted, thus bolstering up the formation. It is this water that through ages past has made possible the accumulation of petroleum. Borne by these underground currents of water, oil has floated into natural reservoirs, where, trapped by hard, impervious cap-rock, it has been preserved until released by the touch of the drill.

As geologists wrangled over the settling of Signal Hill, surveyors, marking out plans for a street improvement at the huge Santa Fe Springs oil field found that measurements made eighteen months previously were in error. Checking with the intricate system of cross levels made in previous surveys, B. P. Sewall, chief

Pushing this handle down, the well shooter sends current to fire torpedo seen at left

Puzzle Geologists

WELLS Long Believed Dead Are Turning in Their Graves, and Their Ghosts Offer Some Strange Problems to the Experts

By Sterling Gleason

DYNAMITE SET OFF AT RIGHT SPOT

The pulley, over which the cable passes as torpedo is lowered, gages the exact depth the charge reaches. The dial tells when feelers grip casing

surveyor, found that these were more than mere errors of measurement. When levels were measured in any direction away from the central point where the error was greatest, the discrepancy vanished. A bowl-shaped depression, six inches deep in the center, has been formed through the sinking of the field.

Meanwhile, at Lagunillas, thousands of miles south, where wells built on piers extending far out into the waters of Lake Maracaibo tap Venezuela's richest oil field, the earth has been sinking steadily at the rate of several inches a year. The formation below is chiefly a loose sandy structure without much strength to retain any cavities that may have been formed by the removal of oil. Only by constructing huge systems of dikes have the oil companies been able to protect their properties against inundation by the waters of the lake. If such is to be the history of other large oil fields, important engineering complications may result.

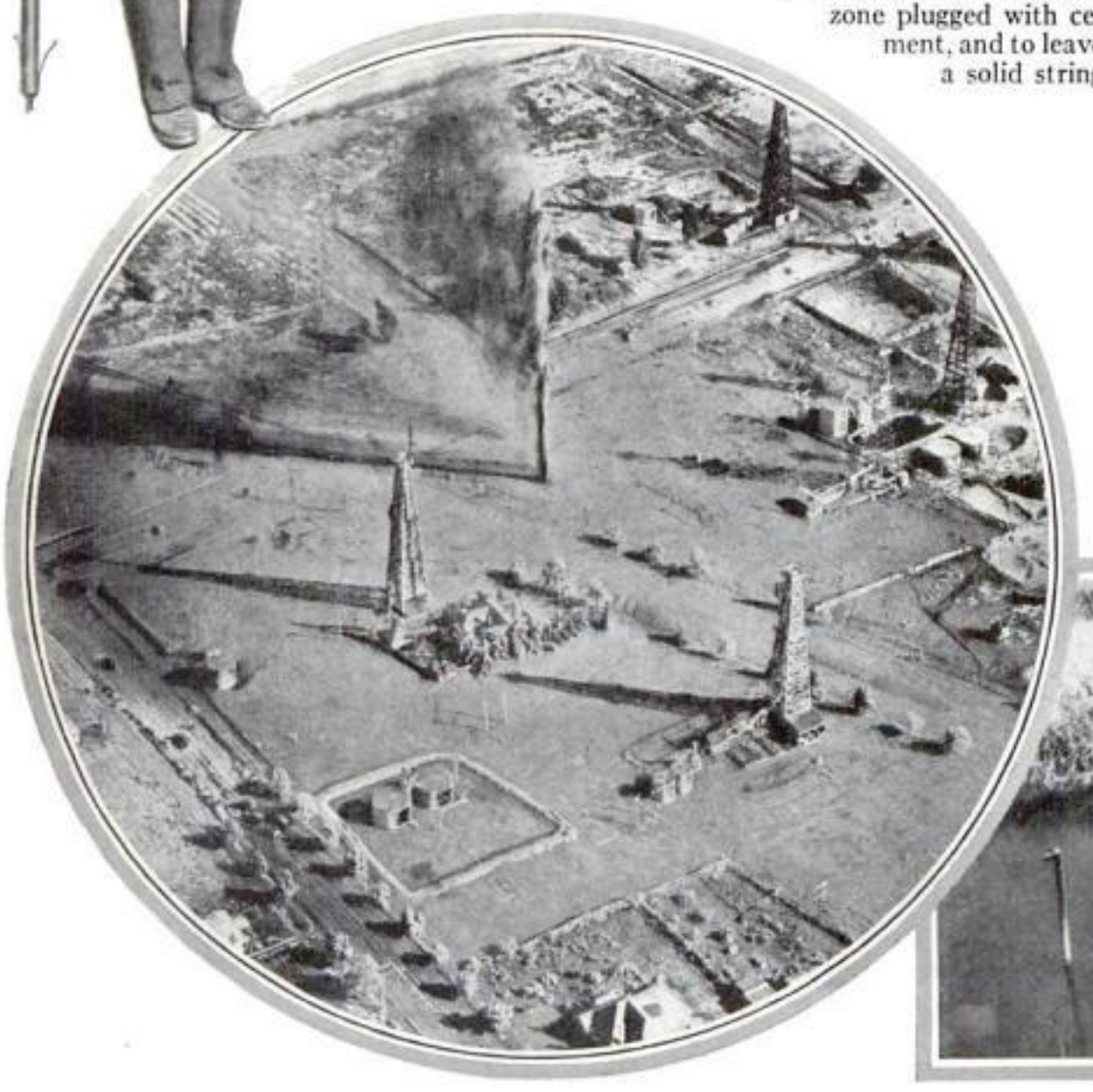
While a producing well may be worth millions, a dead well may be an enormous liability. Oily salt water may flow upward from the bottom of the hole and contaminate fresh water flowing near the surface. Producing wells near by may be flooded by water entering the formation. Reviving gas pressure may send geysers of mud and water spouting sky-high. Keeping dead oil wells quiet in their graves is so much of a problem that strict laws regulate abandonment operations. California compels oil men to leave each oil zone plugged with cement, and to leave a solid string of casing from the top to the bottom.

In their efforts to lay the ghosts of these dead wells, oil men of today are aided by ingenious scientific devices that enable them to work miraculous feats. Heavy strings of tools, armed with hardened steel knives that cut like razors, perform amazing operations of underground surgery. Great masses of cement, shot down to depths of a mile or more, harden instantaneously into artificial rock that plugs cavities and seals strata forever. Dynamite, propelled through casings in torpedolike tubes equipped with metal feelers, unerringly finds its objective and exerts its giant force to finish the operation.

ONLY after all means of extracting oil profitably have failed are oil wells abandoned. Powerful pumps first suck the sands dry or skim the water of its layer of oil. Then the dying gas pressure is boosted by compressors or pumps that "repressure" the depleted sands. Or the whole field may be flooded with water to drive the oil out of crevices, toward wells at the top of the structure. In the old Brea field in California, engineers of the Union Oil Company have reversed traditional methods by pumping high-gravity oil from other fields into the ground to dissolve heavy crude oil that clings tightly to the sands.

Even when geologists have pronounced a well officially dead, it still holds treasure. Each oil-bearing stratum is tapped by a separate string of pipe. A single well may thus have four or five of these concentric strings of casing running to the different producing zones, and may thus hold valuable salvage in the form of ten to twenty thousand feet of pipe, worth from fifty cents to more than a dollar a foot.

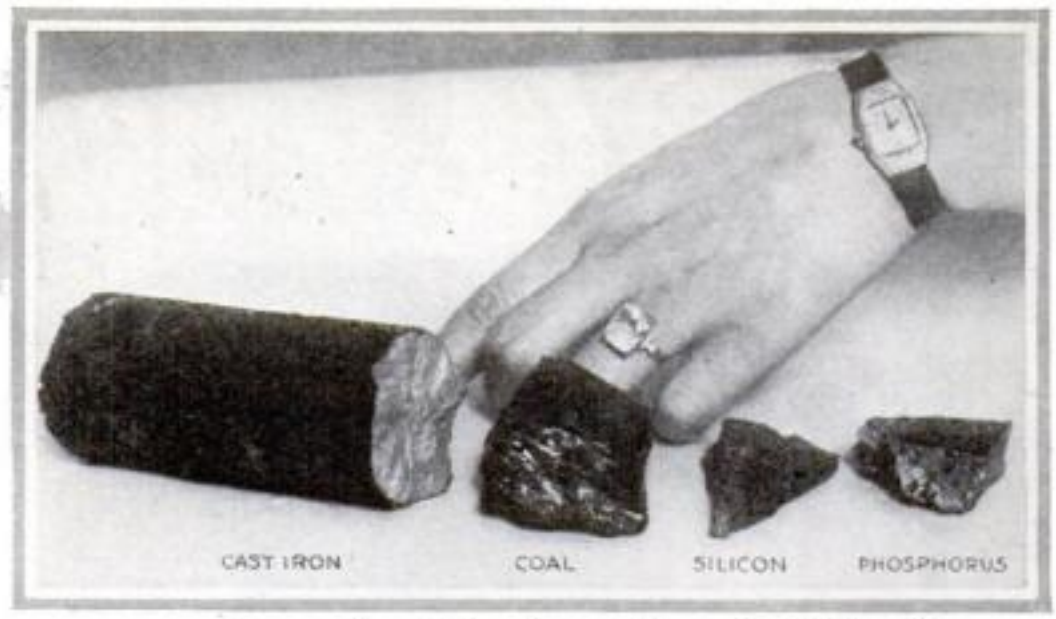
To the site of a dead well comes the oil field "undertaker," a specialist who uses the most modern scientific aids in his work. A huge truck backs up to the derrick and *(Continued on page 103)*



DEAD WELL CAME TO LIFE

Below, the harmless looking hole marked the site of an abandoned well that was thought to be dead. At left, air view of same well when it suddenly spouted oil and mud. The eruption lasted four days

This drill bit is set with eight diamonds that are capable of cutting through the earth's strata of granite and sand to a depth of more than a mile, according to the maker, the Diamond Drill Carbon Co. It is in drilling deep holes that diamonds find an important use



Here are the raw ingredients of diamonds. Coal furnishes carbon that is precipitated by silicon, and phosphorus delays cooling

Professor McKee in his laboratory at Columbia University in the act of melting iron in crucible. The first step in his process of turning carbon into genuine diamonds

DIAMONDS

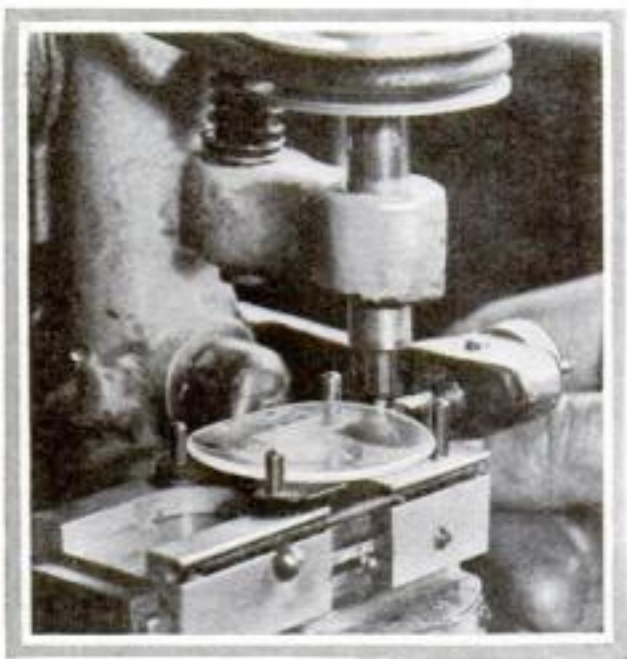
Heat and Pressure in Laboratory

DIAMONDS, one twentieth of a karat in size, have been made in the laboratory. Dr. Ralph H. McKee, Columbia University professor of chemical engineering and his assistant, L. H. Barnett, developed the process that made possible this scientific marvel.

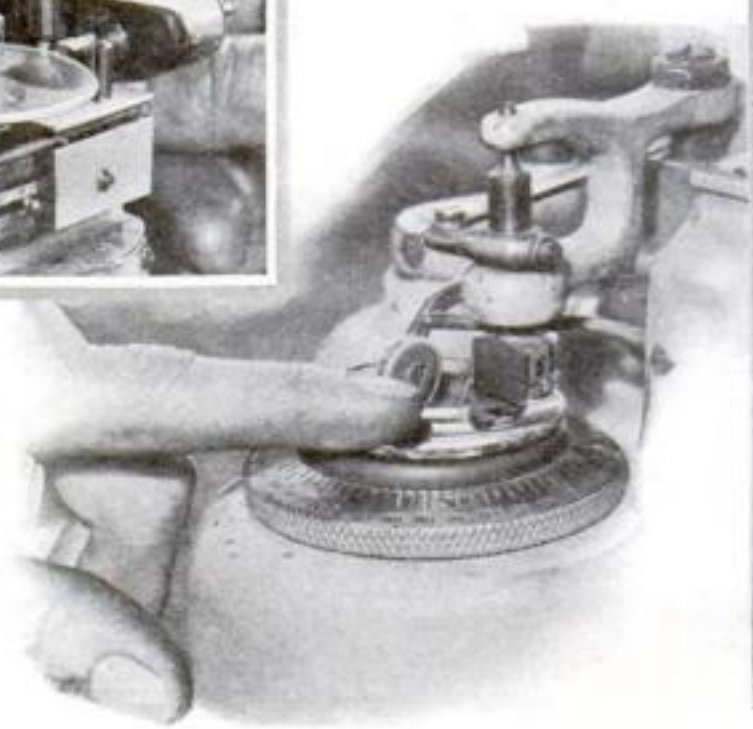
In making diamonds to order, Dr. McKee imitated Nature, using tremendous heat and enormous pressure. With an electrical furnace he brought molten iron, containing carbon, silicon, and phosphorus, to a high temperature and then poured it into specially prepared shells of steel. After the opening was securely sealed, the shell was allowed to cool slowly. In this way an unbelievable pressure was built up in the center of the hot iron.

When cold, the shell and contents were attacked with acid, which ate away the iron, leaving only the small diamonds that had formed from the carbon precipitated by the silicon. In a manner similar to this, it is believed, diamonds are formed in Nature.

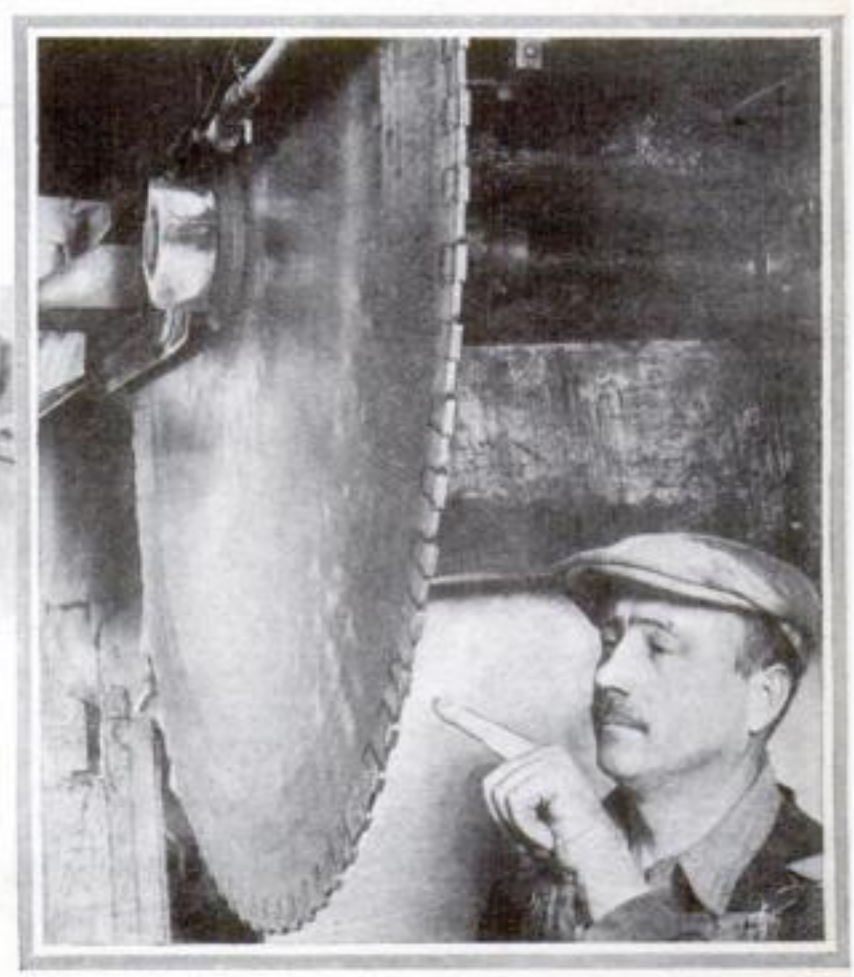
With the knowledge gained by his experiments, Dr. McKee says it is possible to carry out the process on a much larger scale and so produce diamonds of a larger size. At any rate, he asserts there is no limit to the number of small diamonds that can be made, and this

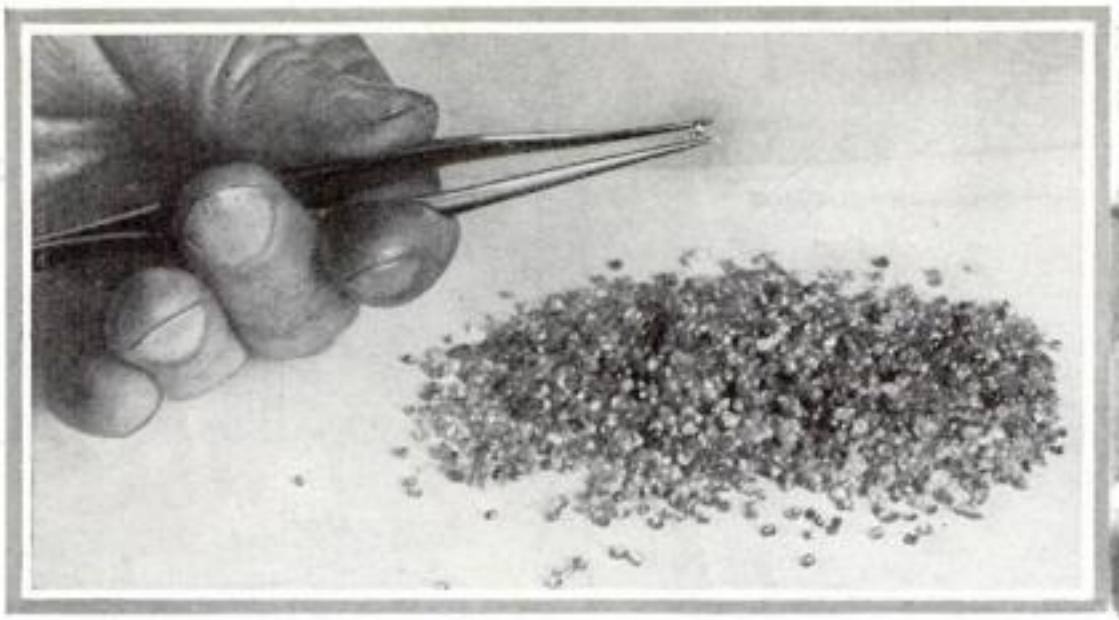


The inset teeth on the big granite saw, right, are mounted with diamonds that slash their way through the solid rock. Each tooth holds eight one-twentieth-karat stones that extend only one eighth of an inch out from the saw



Above, another type of diamond drill. This one is used to bore holes in eyeglasses. At right, the process of cutting a lens is clearly shown and the marks made by the diamond can be seen





The tweezers are holding a diamond one twentieth of a karat in size above a pile of similar stones used in industry for grinding, cutting, and drilling

Steel held against an emery wheel is eaten away in a shower of sparks, but diamond is so hard it cuts the wheel and is therefore used to true and dress abrasive wheels in all machine shops

Made to Order

Imitate Nature in Producing Carbon Crystals

is the point at which his work takes on far-reaching commercial importance and may revolutionize industrial processes.

At present about sixty percent of all diamonds mined in the world are used by manufacturers. If small cheap diamonds were available, their use would be enormously extended. For instance, they would be crushed and made into abrasive wheels that cut steel more than five times as fast as the best wheels now in use. Or diamond dust could be used to coat polishing wheels with which a higher polish can be secured than is now possible.

Naturally, laboratory made diamonds would cut the cost of the operations in which natural gems are now used. The gigantic circular saws with which granite blocks are cut into slabs have inset teeth upon which are mounted diamonds to do the actual cutting. When a job is finished, the saw is weighed and the loss in weight marks the cost of the work in loss of diamonds.

Every machine shop has at least one diamond wheel that is used to true and dress the grinding wheels. Drills that cut their way through great masses of granite in search of the deep-lying oil deposits do their work with diamonds. Thus in grinding, cutting, and drilling no material matches diamonds.

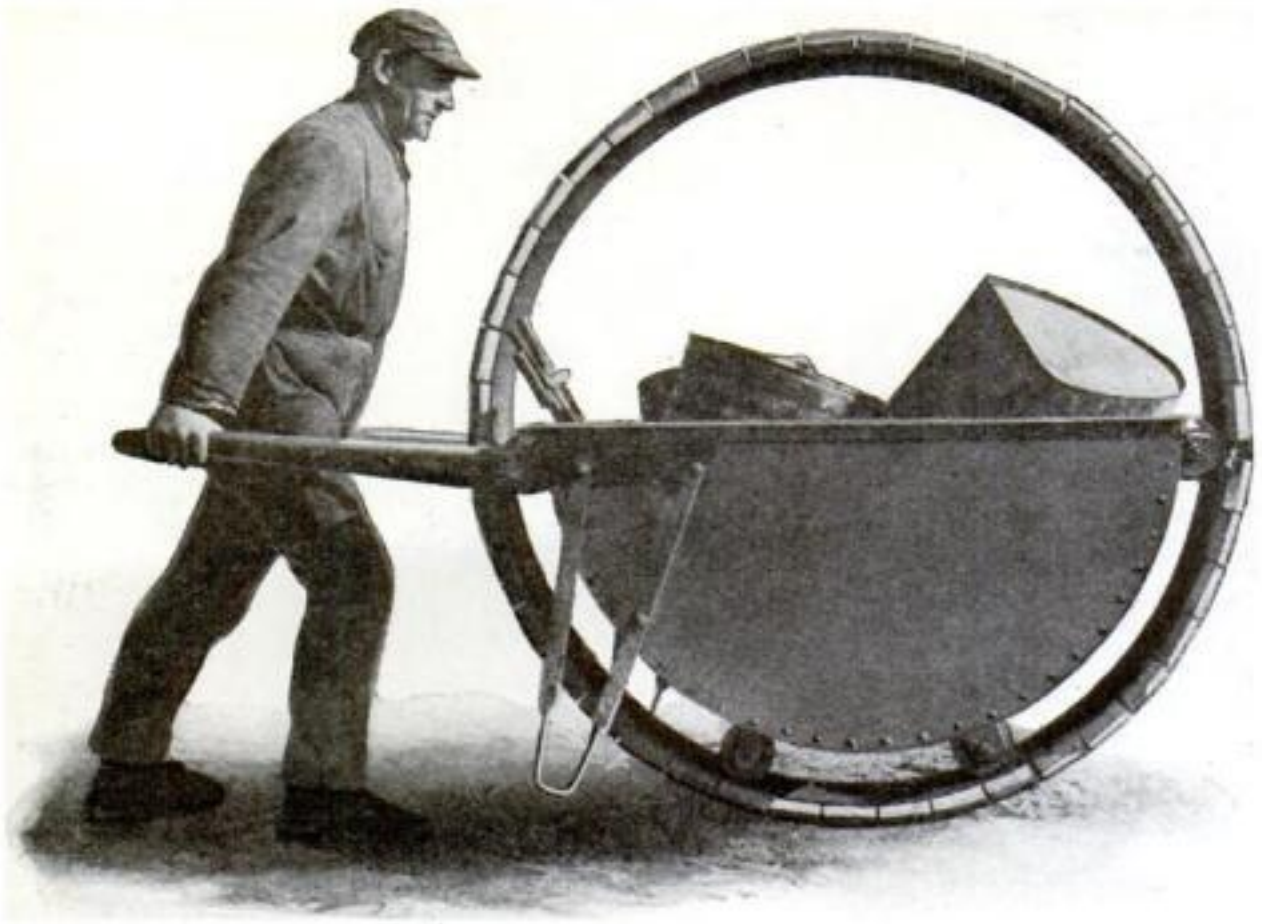
The value of Dr. McKee's method, if capable of indefinite extension, is great, and it is not surprising that he is continuing his experiments to develop bigger and cheaper diamonds.

Even artists need the diamond, as dry point etching on copper is done with it. Above, J. Knowles Hare, noted etcher, is shown working on a portrait using a diamond tool

Slabs being cut from granite blocks with the diamond-toothed circular saw shown on opposite page. Note that during the cutting process a stream of water plays on the work to cool the saw

Last step in the making of a diamond is shown at left. Professor McKee is pouring acid over the cooled contents of a steel shell. When the mass is eaten away, the small diamonds are left

THIS WHEELBARROW JUST ROLLS ALONG



AN ADAPTATION of the motor-driven hoop that recently amazed England (P.S.M., May '32, p. 63) has made its appearance in Germany. It is the "hoop-barrow," a wheelbarrow propelled within one huge wheel. The barrow proper, remaining stationary, is attached by means of rollers to the large hoop which is easily pushed by hand. The new device works on the principle of a rolling drum, rather than on that of the lever, and thus much heavier loads can be carried in it.

BRUSH BOY REPLACED BY VACUUM CLEANER

BY PUTTING a nickel in the slot you may get your clothes brushed, if an "automatic brush boy," recently exhibited at the National Inventors' Congress in San Francisco, Calif., is installed in hotels and stations. The drop of the coin in the box causes an electrical contact to start a motor that operates a small vacuum cleaner brush. This the user applies to his clothes.

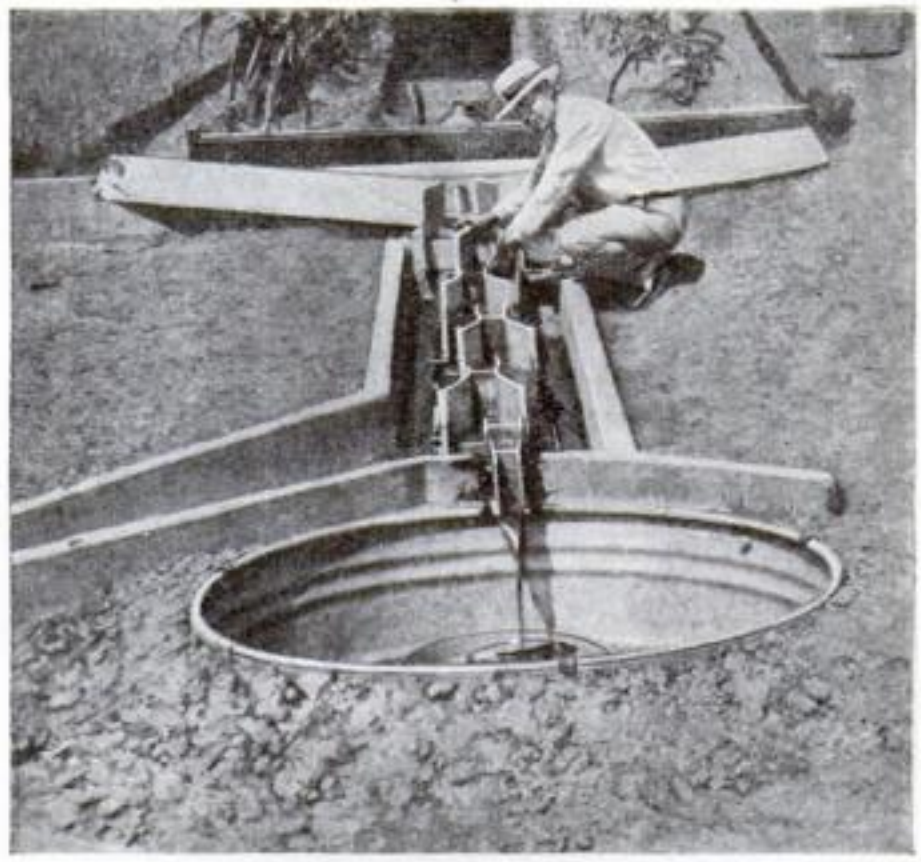
SEX OF UNBORN CHILD MAY BE REVEALED BY CELL STUDY

PREDICTING the sex and mental and physical traits of unborn children may follow successful experiments made by Dr. John Belling, expert on heredity of the Carnegie Institution of Washington. Dr. Belling has photographed the "genes," the hitherto unseen particles that carry hereditary characteristics. Living things hand down their characteristics to their offspring by means of tiny chromosomes contained in the nuclei of the reproductive cells (P.S.M., Nov. '31, p. 132). These chromosomes, in turn, are the carriers of the genes. With the aid of high-power microscopes, Dr. Belling saw and photographed the genes in the pollen cells of flowers. In cells less than one four-hundredth of an inch in diameter, he saw and counted at least 2,200 different bodies which he believes are the units of inheritance mechanism that are responsible for the shape, color, and fragrance of the future plants.

At right, first photo of genes in one cell of the leopard lily

Faint upper row, photo of onion cell, flattened to show genes. Lower row, enlarged drawing of genes

Diagram made from a camera drawing of strings of genes found in a bulb plant



Earth, washed by the rain into this trap, is measured to find loss by erosion

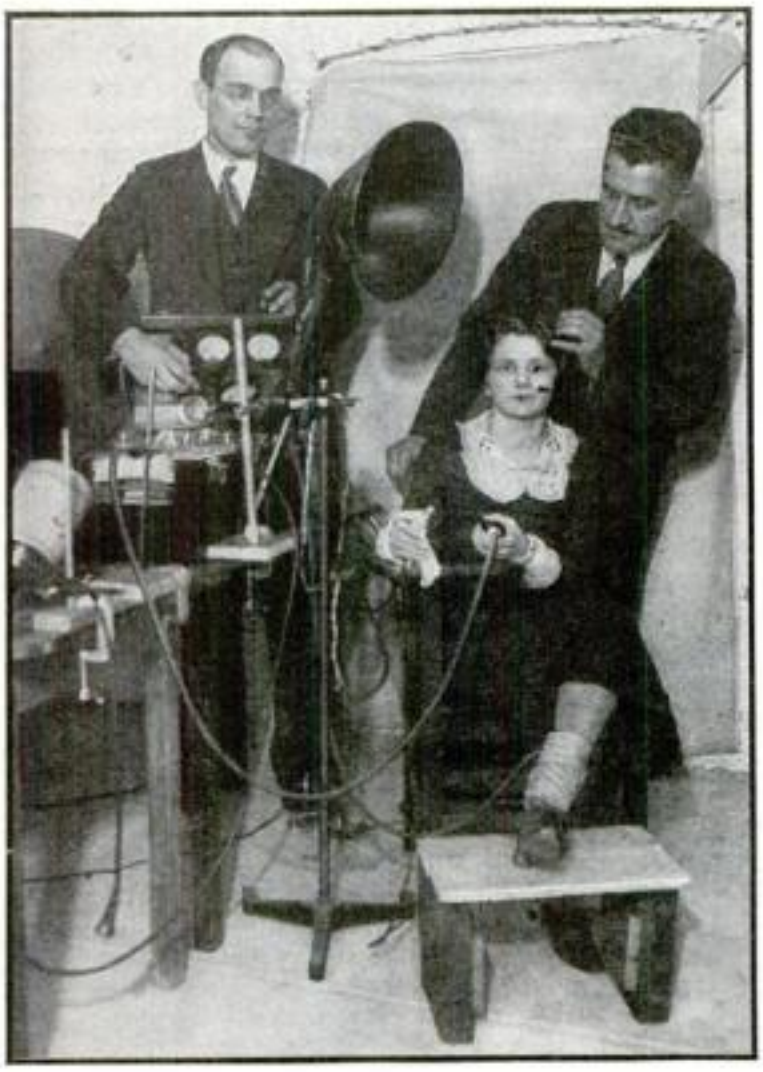
NEW METHOD MEASURES AMOUNT OF EROSION

DAMAGE done on farm lands by water pouring off hillsides is graphically shown by a new device recently placed in operation at the soil-erosion experiment station of the U. S. Department of Agriculture at Bethany, Mo. A concrete trough catches drainage water from near-by fields. In the trough are metering devices that record the amount of water passing through it. A concrete tank at the lower end of the trough catches the drainage water. The soil held in this water is then measured.

BIG TRUCK TIRES ON FREAK CAR

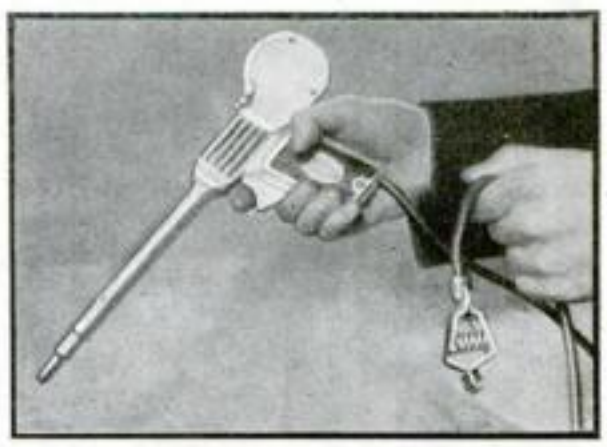
LOOKING like some queer comic paper freak, a car remodeled by Ted Castle rolls through the streets of Los Angeles. It is fitted with huge truck tires, size 44 by 10, held in place by rows of carriage bolts passed through the gigantic shoes and the regular tires inside them. The frame of the car has been underslung, which heightens the peculiar effect. The stiffness of the huge tires is such that they require little or no air pressure.

This freak car, with tiny chassis and big truck tires, was built in Los Angeles



ELECTRIC PISTOL FIRES SOLDER

PULLING the trigger on the electric pistol shown at the right releases solder instead of bullets. The carbon tip is cored and wire solder is forced through this hole. The clip on the wire connected to the iron is snapped onto the ungrounded terminal of the starter battery. When the carbon meets the metal grounded to car's frame, the current heats the carbon tip.



Pulling trigger of this pistol releases a small amount of solder which is electrically heated

DIAL ON HUMIDOR GAGES MOISTURE

A CIGAR humidor with a built-in hygrometer has been introduced in Germany. At the side is the hygrometer which indicates the humidity of the air inside the humidor. The movement of the hand toward the "too dry" end of the dial serves to warn the smoker that water should be added to the moisture pad.

MONOTONOUS NOISE MAKES GIRL SLEEP

EVIDENCE that monotonous noises induce sleep has been produced by Professor John B. Morgan of Northwestern University. He placed a young woman student in a chair and attached various recording instruments to keep track of her pulse, respiration, and other body functions that change during slumber. Throwing a switch, he started a steady, airplane-like hum from a loudspeaker. In a short time the instruments definitely proved that the girl was asleep despite her best efforts to keep awake.

TABLE FOR AUTOMOBILE CLAMPS TO ROOF

A TABLE for use in automobiles has been invented by C. R. Richardson of England. Utilizing the principle of the lazy tongs, he has designed the table to collapse against the roof of the car when not in use. It can be pulled down to any elevation desired and the backward-forward position also may be adjusted. When once in the desired location, either for use or storage, the automobile table is held securely in place by clamping thumb screws that prevent movement and rattle.

ELECTRICITY KEEPS HOUSE FOR GENERAL

Right, electrically operated machine to stir breakfast porridge. Below, an apparatus by means of which grubs are killed

Garden frames, built like bookcases, with glass ends, tops, and sides, have been designed by an English general whose ingenuity makes his Thames River home run itself

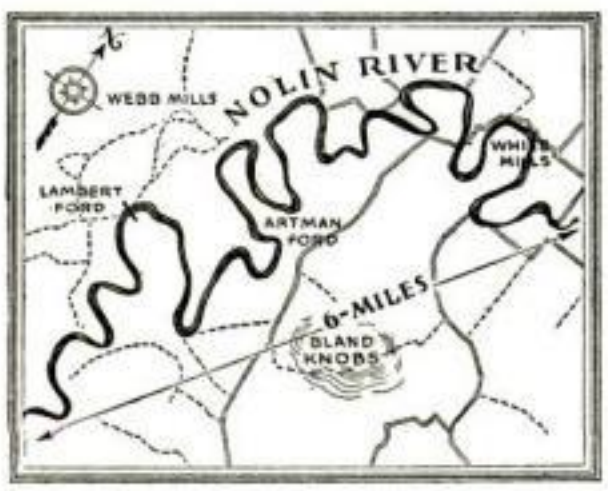
To MAKE life more comfortable in his little cottage beside the Thames River, near Marlow, England, a British war hero, Brig. Gen. J. B. Wroughton, has fitted his home with a multitude of labor-saving devices of his own invention. By pressing a button or closing a switch, the majority of his household tasks are performed. Easily reached from the bed, one electric button lights up the clock so that the time may be read. Another automatically draws the curtains. An ingenious device in the kitchen, working by electricity, stirs the general's porridge. His garden frames are patterned after bookcases in a novel design that he originated, and slugs are electrocuted by a system of wires from the house circuit.

MATHEMATICAL PENCIL TOTALS BRIDGE SCORE

CALCULATING a contract bridge score is made easy by a pencil recently placed on the market. When its movable barrel is turned, figures appear in three windows. The user sets the barrel to the number in the central window, showing the number of tricks over or under the contract and reads the score under "not vulnerable" or "vulnerable" in side windows. Figures show the total for "not doubled" or "doubled."

AMERICA'S CROOKEDEST RIVER IS MAPPED

WHAT is called the crookedest river in America has just been mapped by the U. S. Geological Survey. The map shows that the Nolin River, which crosses Hardin County, Kentucky, travels a twenty-mile course to advance a total distance of six miles.



America's crookedest river, in Kentucky, runs twenty miles in an effort to advance only six

FISHERMAN NO LONGER NEED HOLD THE POLE

EVEN the task of holding the pole is now spared the fisherman, since the invention of a "lazy man's holder" recently shown at San Francisco, Calif. It is provided with a clamp for attachment to the side of a boat or a limb of a tree, and may be set at any angle. Nothing is left for the fisherman but to watch the line.

LIFE-SIZED ROBOT MAN DANCES AND SINGS

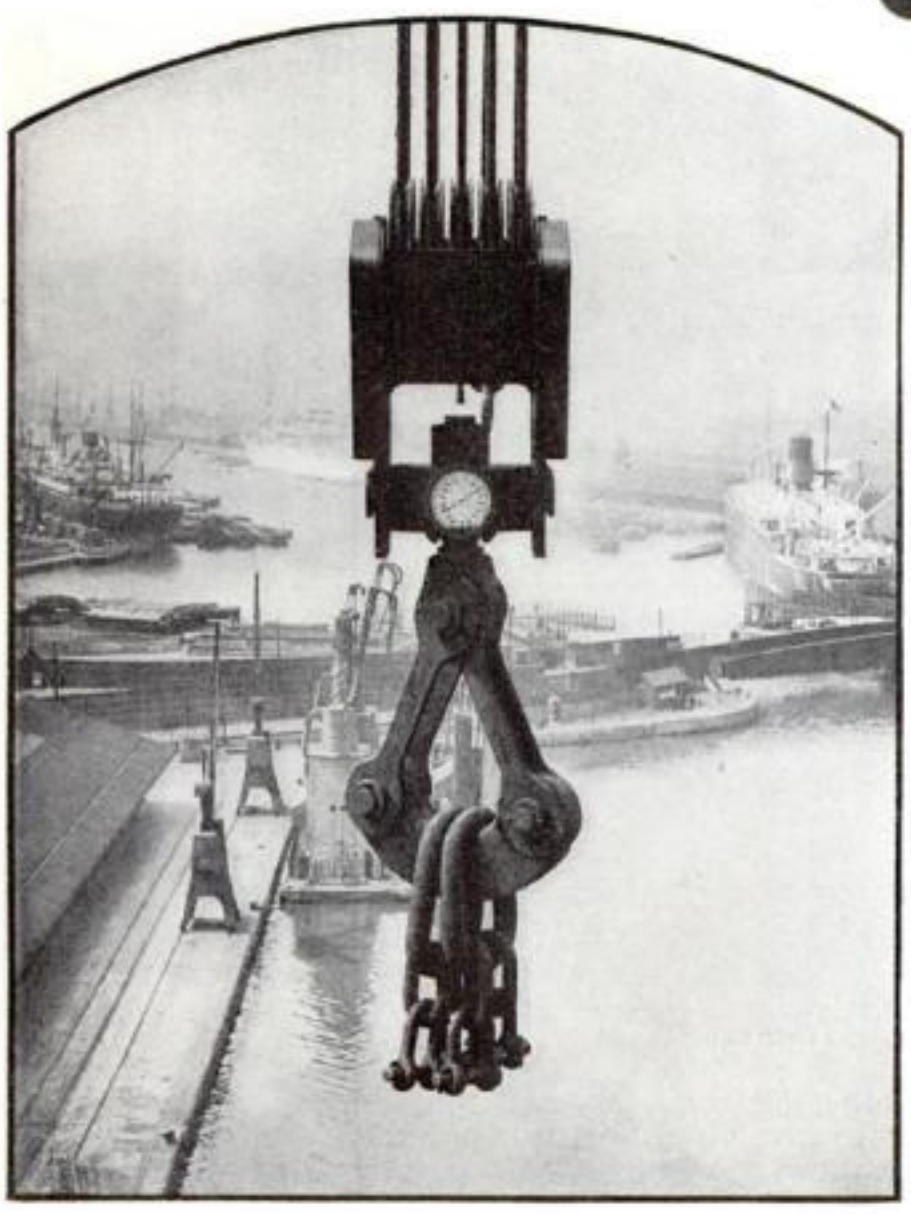
NOT only does a new mechanical man talk and sing, but he dances to radio music. This man-sized robot, designed by a German engineer, has a loudspeaker mechanism for a brain, and the vibration of the speaker closes relays that operate his arms and legs. The dummy, says the inventor, may be an attraction for a radio shop.

Floating Edge on Wings Keeps Plane Out of Tail Spin

AN AIRPLANE designed by G. W. Cornelius, California aviator and inventor, has wings hinged at the front so that the trailing edges can move up and down in response to variations in wind pressure and "bumps" in the air. He claims that a tail spin is impossible with this construction and that the plane will fly virtually without manual control.

This remarkable plane has no ailerons as used on conventional types of ships, the thirteen-degree movement of the wings making them unnecessary. Note in the picture below the dropped position of the wings with relation to the fixed center, and the special supports to the trailing edges of the wings as pointed out by Cornelius in the illustration at the right.

Above, G. W. Cornelius, inventor, pointing out floating edge on wing of plane designed to give stability. At left, Cornelius flying the plane while seated on rear edge of cockpit and not touching controls



GIGANTIC HAND LIFTS 150 TONS

A HUGE steel hand that will lift and at the same time weigh a full sized locomotive is the latest thing on a gigantic floating crane in England. The scale that registers the weight picked up is set into a crosspiece between the five-sheave block and the tackle. The bending of a stiff steel member caused by the load is multiplied by tiny gears to operate the pointer. No ordinary crane hook is used, as such heavy loads must be supported by chains to distribute the strain.

TRAY HOLDS SODA GLASS

CHILDREN may now patronize soda fountains as easily as the grown-ups. A tray brings the glass down to a convenient level. Made of aluminum, the tray folds for compact storage. A long bar clamps it to the inner side of the counter as shown.

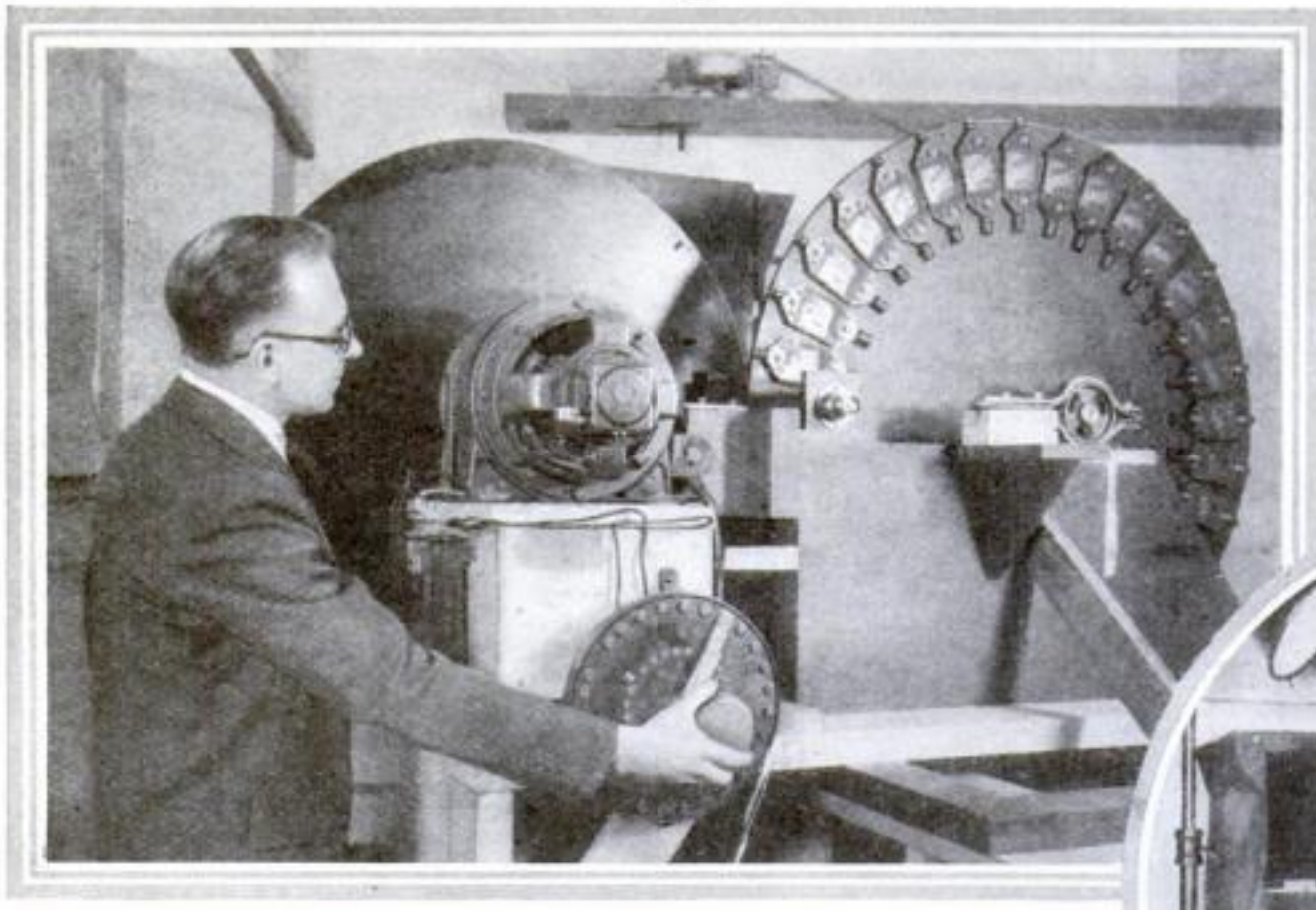
Tray, held by bar across fountain, brings soda close to tiny patron

CHECKS CUT ROAD PERIL

THE PRACTICE of painting dangerous road obstructions with a black and white checkerboard pattern makes the motorist careful when he sees the familiar design. The newest idea to protect the street worker against the hazards of auto traffic is to clothe him in a jumper patterned with white and black squares. Motorists will have little difficulty in seeing the checked jacket.

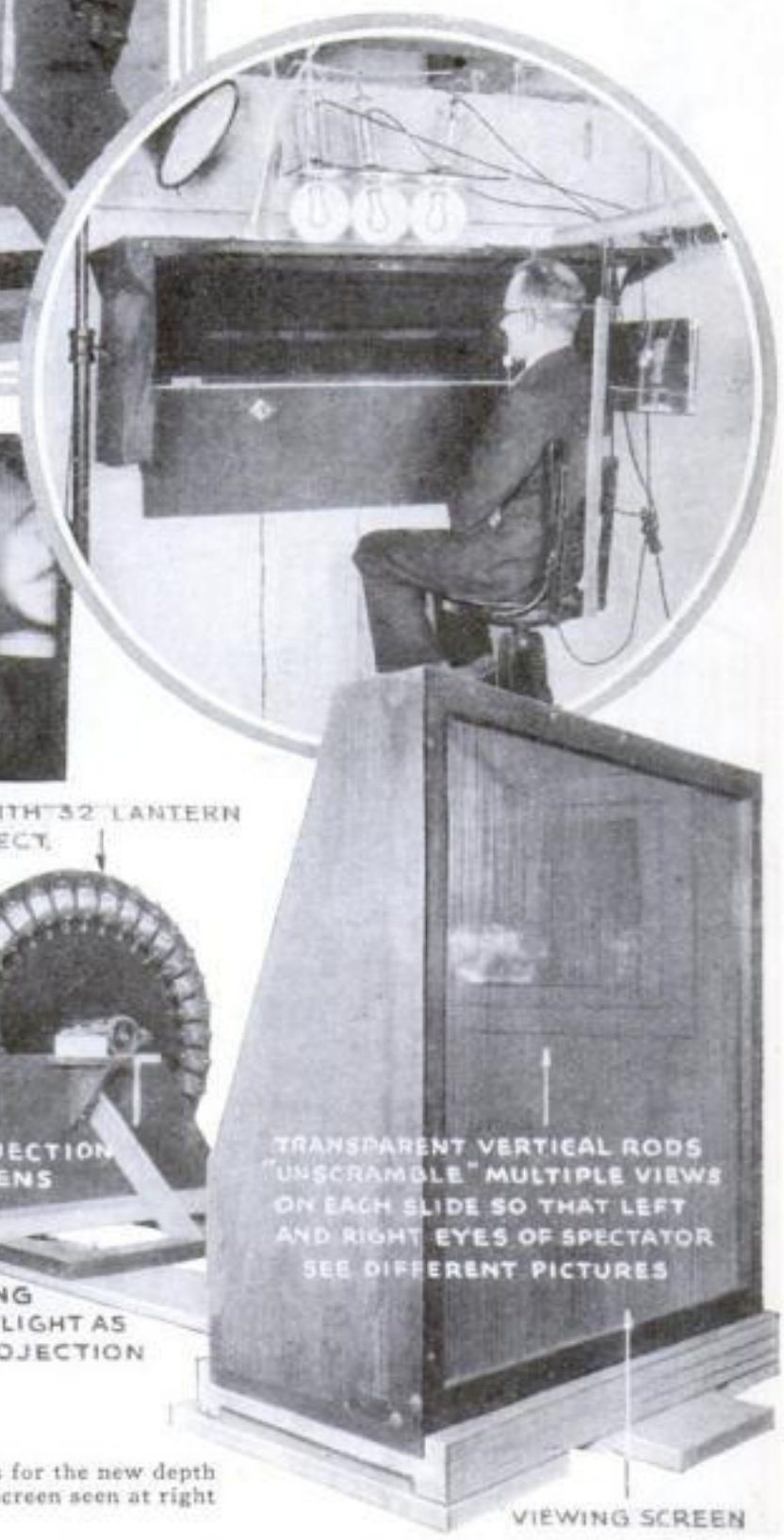
Lifelike Depth Given to Movies

New Process Adds Long-Sought Third Dimension to Pictures on Screen



LIFELIKE MOVIE PROJECTOR

At left, a close-up of the projector. Thirty-two lantern slides of the subject are mounted on a wheel and revolved while light flashes through them. Below, taking the picture. The subject is filmed from many angles



The projection apparatus for the new depth movie with the viewing screen seen at right

Three views of the projected picture as it was seen on the screen by three different spectators, one seeing it from the right, one from the center, and one from the left

ONE of the long-standing dreams of photographers—to be able to produce a picture with lifelike, three-dimensional depth—now seems on the verge of realization. How it has been accomplished on an experimental scale was demonstrated recently by Dr. Herbert E. Ives, of the Bell Telephone Laboratories, noted for his pioneer researches in electrical picture transmission and in television. He exhibited a motion picture that, during the few seconds of its projection, showed the moving head and shoulders of a man with the perfect illusion of standing out from the background.

To make this picture, Dr. Ives seated his subject before a four-foot concave mirror like those of a reflecting telescope. It cast the subject's image, through a transparent screen ruled with 200 minute concave grooves acting like lenses, upon a single photographic plate. As the subject moved, the plates were changed and thirty-two such pictures were made in succession.

Lantern slides made from the developed pictures were then mounted firmly upon a large revolving disk, and their images thrown in rapid succession upon a special viewing screen. This was composed of vertical, transparent rods, accurately ground to cylindrical shape at front and rear and about a quarter of an inch wide. Seen from the front, each picture had realistic depth, and successive views blended into a three-dimensional movie.

The taking screen, Dr. Ives explained, combines upon a single plate the images that would be seen if the subject were viewed from every possible angle. If projected directly, the resulting lantern slide would be a blur of vertical streaks, but the rods of the viewing screen disentangle the superimposed views. Thus the left and right eyes of the spectator actually see different pictures, just as they do in everyday life, because of their difference in viewpoint. A stereoscopic or three-dimensional effect is achieved without twin pictures or special hand-viewing devices previously used by experimenters.

At present the apparatus is admittedly bulky and cumbersome, and this together with the briefness of the motion picture obtained precludes its immediate commercial use. Both limitations are imposed by the large photographic plates used to register the delicate patterns of vertical lines with the required accuracy. If a way can be found to adapt standard motion picture film to the process, theater patrons may soon witness the latest triumph of photographic science.

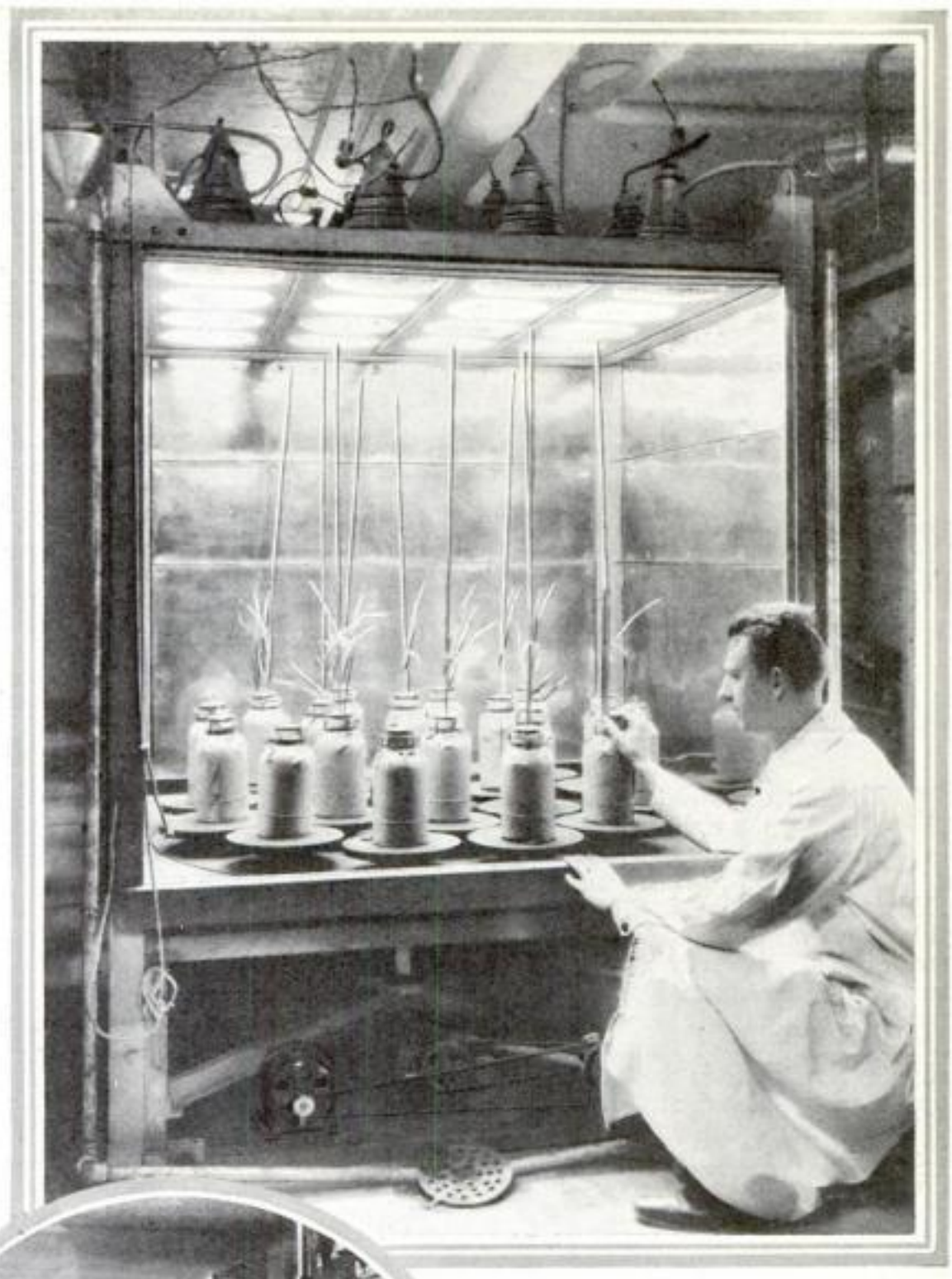
New Tests Suggest that

PLANTS Can Think

NEW evidence that growing plants may have "brains" and display reasoning power has been announced by the Smithsonian Institution at Washington, D. C. The discovery was made by Dr. Earl S. Johnston, who, it is reported, has found in plants a striking similarity to the intelligence of human beings.

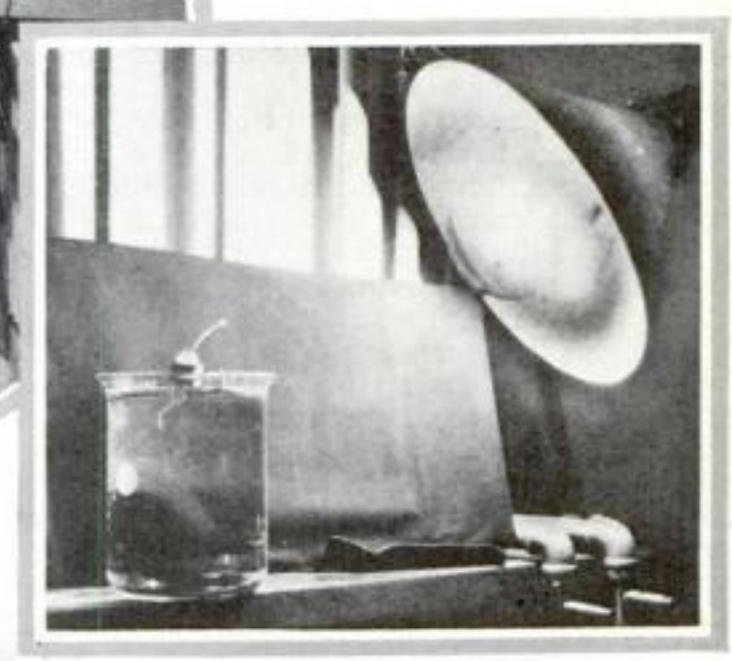
His tests and those of other experimenters have centered upon one problem—the mysterious ability of plants to turn their stems and leaves toward the light. After two years of study he concludes that every plant behaves as though it had a more or less localized region, a sort of "brain," that reacts directly to the stimulation of light. In seedlings of oats and wheat, the supposed brain is centralized in the tip of leaf sheath that encircles the bud of the growing shoot. The first millimeter (about 1/25 of an inch) is 160 times as sensitive as the second and 1,800 times as sensitive as the third. European experimenters had already discovered that if they cut off the head of a seedling it lost its power to turn toward the light, but regained it when the tip was grafted back on again.

Now Dr. Johnston is investigating the mysterious manner in which this "brain" operates, if it exists, and how it gets its message to the lower part of the plant's stem where the bending occurs. To study the process he exposes growing seedlings to light of different colors. Plants are selected for their straightness and set perfectly upright in a cabinet, exposed on each side to light of a different color. After half an hour the bending of the plant toward the light having the stronger effect may be observed with a telescope. By delicate control of the lights' intensity and wave length, a precise comparison of their effect may be made. Blue light proves most exciting.



In preparing plants for brain tests, they are first grown in a chamber where they are revolved on a turntable beneath water-cooled lamps in order to secure uniform specimens

To measure the intensity of light in the plant tests, delicate instruments were developed. At left is a new lamp gage used by Dr. Johnston



Is it brain or heat reaction that makes a plant bend toward the light as the mustard seedling above turns toward the 200-watt lamp?

Sprouted seeds, left, are transferred to a net for their early growth. Later they will be used in remarkable "intelligence" tests

It Never Rains Cats and Dogs BUT...

It Does Rain FISH!

LIVING Creatures Actually Fall with Rain from the Clouds, and This Article Tells When and Why Such Strange Things Can Happen

By ROBERT E. MARTIN

UNTIL three o'clock in the afternoon, the eighteenth of May had been like any other spring day on the farm of W. L. Doughtie, Edgecombe County, N. C. Then strange things began to happen. Dark clouds swiftly gathered overhead. Suddenly, there was a heavy downpour. Doughtie, who had put his horse in the barn, was about to go into the house when something cold and slippery struck him in the face. He looked up. It was raining fish!

The farmer could not believe his eyes. He called his wife. Behind her, the children crowded in the doorway. Spellbound, they watched the "miracle." Hundreds of fish dropped from the sky. Down they came, like giant, solid flakes in a nightmare blizzard. They plopped on the ground of the barnyard; plashed into the rain barrel; smacked against the porch roof, the chicken house, the machine shed.

As suddenly as it had started, the fish shower stopped. Rushing barefoot from the house, the Doughtie children waded into puddles, found them filled with little fish, alive and dead. They were from one and one half to three inches long. A plot which only a few days before had been planted in cotton was covered with them. The children caught many of the live ones, triumphantly carried them to the house in pans of water. They converted an unused well into an aquarium, where they kept a number of the creatures alive for weeks. Altogether, the fish storm had spread over three acres of Doughtie's land.

That was four years ago. Doughtie told his neighbors of his startling experience. Though none but the farmer and his family had seen the phenomenon, his reputation was such that his account was believed. But nobody could offer an explanation. A friend advised him to tell his story to a scientist of whom he had heard, a North Carolina man, now in New York, who was an expert on matters pertaining to fish—Dr. E. W. Gudger, of the Department of Ichthyology of the American Museum of Natural History.

Doughtie acted on the suggestion. This started Dr. Gudger on a trail of fish rains that, in a manner of speaking, took him clear around the world and back into the Dark Ages. Recently, he completed his researches. He found that rains of fish, though rare, actually occur; have occurred in virtually every part of the globe since A.D. 200; and in all likelihood will occur again. He gathered records of seventy-one such showers that have astonished and frightened people in the last 1,700 years. And he also discovered the cause of this curious phenomenon.

The other day, Dr. Gudger told me about his unique investigation.

"Almost everybody," he said, "at one time or another uses the expression, 'It's raining cats and dogs,' or, 'It's raining pitchforks,' though no domestic pet or farm implement ever has been known to drop from the skies. On the other hand, nobody would think of saying, 'It's raining perch and pike.' Yet showers of those fish and many other varieties, including trout, catfish, herring, and whitefish, really happen. On a few occasions, it also has rained frogs; and in the old days, mice and worms were reported to have fallen."

Aside from the shower on the Doughtie farm, which as far as is known is the most recent, Dr. Gudger found more than a dozen recorded fish rains in the United States, among them one in Mississippi in 1915, another in North Carolina in 1913, in South Carolina in 1901, in Rhode Island in 1900, in New York in 1900, in Florida in 1893, in South Dakota in 1886, in New Jersey in 1875, in Louisiana in 1875, in Vermont in 1859, in Maryland in 1829, and in New York City in 1824.

When it became known that Dr. Gudger was interested in fish rains, several accounts from reliable eyewitnesses were sent him. The first was that of the Rhode Island rain. It was given by Richard H. Tingley, of Port Chester, N. Y., an old friend of Dr. Gudger's, who was caught in a fish rain on the outskirts of Providence on May 15, 1900.

In the late afternoon of that day, a thunderstorm with a high wind brought a torrent of rain. Suddenly, a blinding flash of lightning, followed by a terrific crash, rent the black clouds. A moment later, streets and yards for several blocks were alive with squirming little perch and bullpouts, from two to four and a half inches long. Tingley himself was pelted with them. Everywhere, windows opened, dis-

HEAVY DOWNPOUR OF FISH. In Transylvania, in the eighteenth century, there was a fish rain, recorded in this old wood engraving, in which hundreds of fish fell from the sky

Innumerable Fish Rains Have Occurred Since Dawn of Recorded History

closing wide-eyed, open-mouthed women, men, children. Boys, soaking wet, rushed about catching the fish, and later sold them by the pailful. A reporter of the Providence *Journal* gathered a bucketful of them. Displayed in shop windows in one of the main business streets, these fish created a sensation, which was heightened by the vivid description in the *Journal*.

A number of similar stories came in rapid succession. Bailey Williams, of 5 West 125th Street, New York City, told how, in the summer of 1900, he and some other boys after a hard shower found fish in puddles at the intersection of Barthel and Genesee Streets, Buffalo, N. Y. An incident of the same kind was related by William C. Biddle, of 107 Chambers Street, New York City. About 1875, when a lad on his uncle's farm near Woodbury, N. J., he and a young cousin were caught in a heavy rain and sought shelter under a shed. When the sun came out and the boys resumed their walk, they were amazed to come upon half a dozen tiny live fish in the grass and the sand.

Seeing fish drop past his office windows was the weird experience of S. W. Narregang, of Houston, Tex., who at the time, about 1886, was in business in Aberdeen, S. D. He rushed to the roof of the building and found it transformed into a fishpond. James R. Daniels, of 200 West 109th Street, New York City, is the man who saw a "heaven-sent" frog. Living in Wilson, N. C., in 1913, he left his house for a walk after a heavy rain, when he saw a dead frog on the sidewalk. A neighbor told him it had just dropped from the sky. Daniels laughed. He was still laughing when a small fish fell at his feet!

Those stories turned Dr. Gudger into a veritable fish-rain enthusiast. Delving into ancient books, he discovered that records of this queer phenomenon go back almost to the beginning of the Christian era. The oldest account he found in "The Deipnosophists, or Banquet of the Learned," dating from the third century A.D., but not printed until 1524. In this rare volume, the author describes a fish storm on the Greek Peninsula that lasted for three days.

In A.D. 689, during the reign of King Otho the Sixth, strange meteorological disturbances were observed in Saxony, among them a fish rain, according to Conrad Wolffhart, whose "Book of Prodigies" was published in 1557. This writer also tells of a rain of frogs in Germany in 1345. Wolffhart made quaint drawings of both phenomena. Illustrations of the same naïve kind accompany a chapter on fish and frog rains in a book by Olaus Magnus, Archbishop of Upsala, Sweden, which appeared in 1555. The good archbishop also referred to rains of mice and worms.

Skipping a century, the next report, contained in the "Philosophical Transactions of the Royal Society of London" for 1698, tells of a fish rain that covered two acres in Kent, England, around Easter, 1666. It emphasizes that the creatures fell on meadowland far removed from any body of water. Other old records state that fish rains occurred in Galway, Ireland, in 1684; in Germany, in 1771; in the Prince of Wales Islands, in the East Indies, in 1816; and in the streets of Paris in 1819.

The skies of Scotland have been productive of fish, mostly herring fry, a number of times. *(Continued on page 108)*

Thrilling Air Battles

By ANDREW R. BOONE

At left, Elmer G. Dyer, Hollywood cameraman, with the apparatus he uses in filming air thrillers. One of Dyer's scenes, above, shows an airplane attack. It was taken with a camera fixed atop the fuselage of Dyer's large film-shooting aircraft

FIFTY-FOUR trim young men in military uniforms gathered around the blackboard.

"We will fly across the sun this morning," the leader told them. "The black ships will fly in from the south, the whites from the north. I don't care where you meet, but stay above the clouds. Since this will be a left to right shot, the camera ships will follow the black formation. Cameras will open up when you're about 2,000 feet apart."

As he spoke, J. B. Alexander, veteran air director of talkie thrillers, sketched the action on the blackboard. For six weeks the fifty-four pilots had been practicing formation and stunt flying, going up daily from Oakland airport and dog-fighting above the white clouds, recording a few minor scenes and perfecting themselves for a great air battle to be incorporated in a forthcoming movie.

"Three camera ships will shoot the fight," Alexander continued. "Elmer Dyer will have number two, flying at 5,000 feet. Number one camera plane will lay on the level, 2,500 feet ahead of Dyer. The third ship will fly 500 feet above number two. Have you got that all okey?"

"Okey," the pilots chorused.

Engines roared, wings that had seen service across the German lines swept easily into the air, camera ships climbed rapidly to their posts. A movie thriller was in the making.

Soon the two formations could be seen approaching each other, closing the gap at an aggregate speed of 200 miles an hour. Forty-two days of preparation, including long drills at the blackboard, had preceded this big shot. No one worried about sound, for the conversations, shouts, and roaring engines were "dubbed" in the studio later. With fifty-four airplanes flying at each other's throats, each must find its niche as the two flights met and broke up in swirling dogfights.

"Purely a question of mathematics," Alexander explained. As the two met head-on, the right wing swept to the left and into a fighting circle. The lead ships stood virtually motionless in the air, as they banked vertically, while the end planes dashed at top speed around the ends. In less time than you take to read this paragraph, the various planes, banked and flying in such a small circle they could do nothing but spin, fell quickly out of the picture. Briefly, each formation had moved up on its collective wing, and enfolded the other in a giant circle. A few brief flashes on the screen thus gave an impression of a fight of considerable proportions.

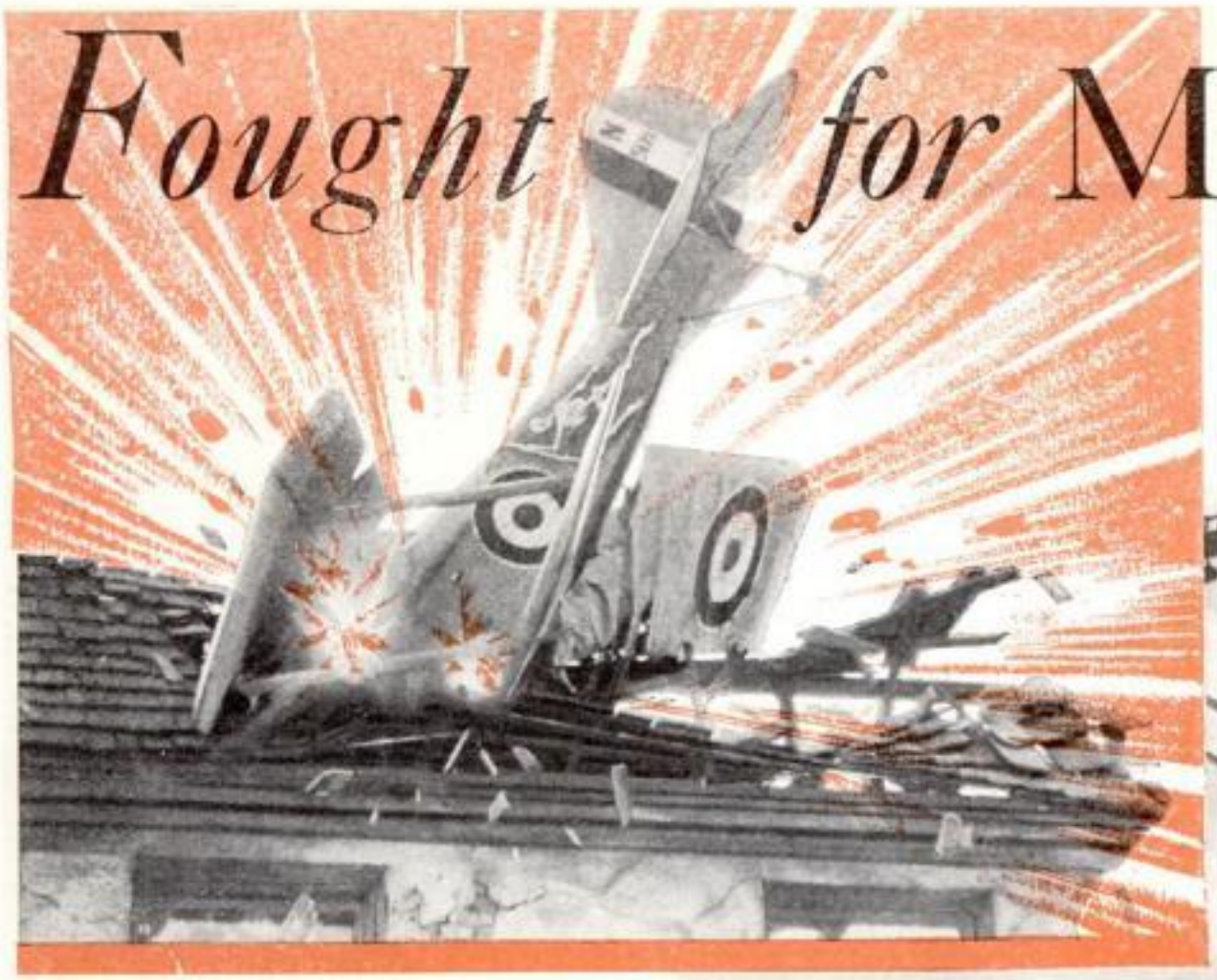
As the two formations met, one of Dyer's "double-headed" cameras, mounted on a single bracket, recorded the whole scene while the other reached out for close-ups of individual planes as they skidded perilously around the air.

Whether the script calls for a giant air battle or a simple formation of two planes, the pilots spend two hours before a blackboard for every hour in the air. If a director wants two planes to dive through the screen, entering at the upper left and emerging at the lower right, the camera

How the Illusion of a Crash

1 Pictures are taken of a plane flying under the telegraph wires and just clearing haystack as shown by dotted line. Left half of above scene is all that is shown on the screen

Fought for MOVIES



No pilot risked his life in crashing this plane, as it fell from a platform and dynamite was used to give the proper effect

Out of control and on fire, one of these war planes fell. But the **smoke was supplied by smudge pots and there was no fatality**

ship and planes to be photographed fly to the location, with the object planes 1,000 feet higher than the camera. When the camera pilot waggles his wings, the two stunt pilots turn their planes down in a steep dive, building up all the speed possible. Then the cameraman slips his camera ahead to permit an entry at the left and as the two ships thunder by he records, if fortunate, a thrilling chase.

No action, no matter how thrilling otherwise, is worth a cent unless there be some background of mountains or clouds against which the speed of the planes can be measured by the audience. Again, the background must be fairly close, else this sense of speed will be lost.

Take the case of a single plane flying as bait to induce the enemy to attack. In one scene the picture showed a lone fighter suddenly wagging his wings, calling for his mates to dash in to the formation. What the camera actually revealed was the sudden wagging against the blue background of a cloudless sky, then for 300 feet of film his ten mates sailed slowly into the picture. No dash, no climax, no thrill!

The picture must be condensed, held within thirty feet of film. Manifestly the camera could not be slowed, as it can for some scenes on the ground, for it would show the planes bumping crazily through the air, destroying the rhythm of flight; nor could the speed of the planes themselves be increased sufficiently, since there is only about a thirty-mile difference between their top and low speeds in flight.

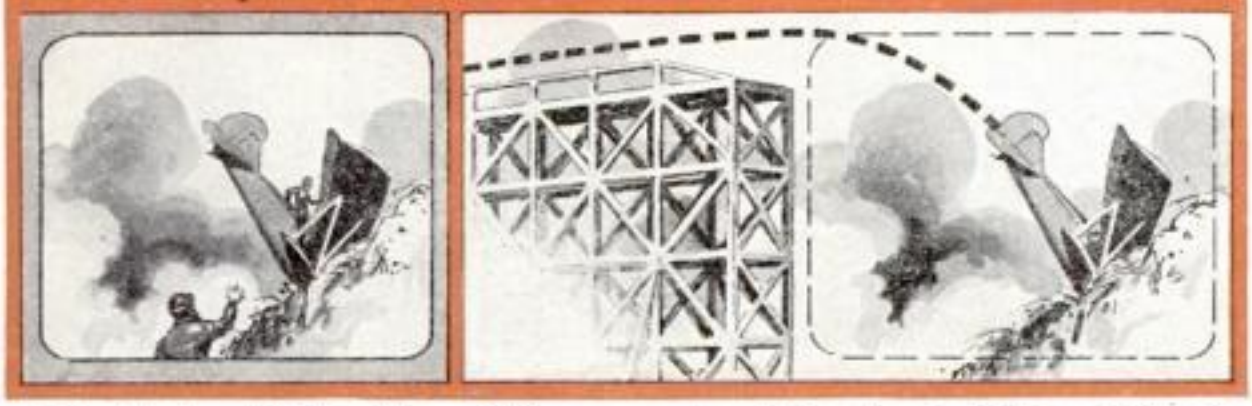
So to the blackboard and diagrams went the pilots. For eight hours, after three tries in the air, the pilots studied their individual maneuvers. The example of a single plane will serve to illustrate how the scene finally was planned and executed. The leading pilot, flying off the starboard beam of the camera ship, waggled his wings. Fifteen hundred feet ahead and 1,000 feet above to the right flew the plane that was to take its place third in line on the left side of the formation. When the pilot of that plane, looking down and back for the signal, saw the waggle, he half rolled on his back and dove straight down. Meantime the plane below was flying straight ahead. When the top pilot reached the top of the screen, or camera angle, he spiraled, still on the wrong side of the formation, made a corkscrew turn, entered the picture diving at 200 miles an hour, leveled off, and crossed over to enter the formation from the left.

Meantime nine other pilots were diving, making corkscrew turns, forming crazy patterns in the air, joining up in perfect formation, while the leading ship was moving only 1,500 feet ahead, all for a thirty-foot strip of the finished picture. Even after this dangerous maneuver, only seven of the eleven planes appeared in the picture, for after that number had closed in on the leading plane, enough of the scene to get over the idea of quick contact had been recorded and the remaining pilots could look for fame elsewhere.

Alexander, while directing this scene, flew slightly ahead and to the left of the camera plane. "Here we were flying tight formation with the rear plane leading," he grinned. "If the camera ship slowed down, I hung onto it backwards. Sounds crazy, doesn't it?"

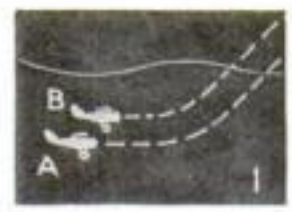
Each plane to be photographed bears

in an Airplane Is Created in a Movie Thriller

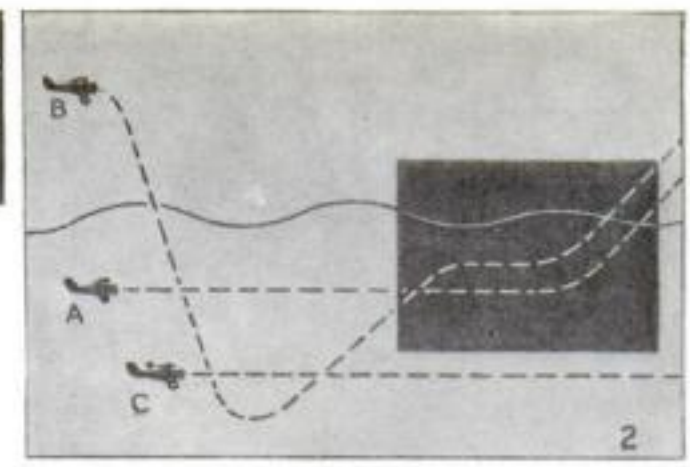


2 An old plane is "planted" in haystack and close-ups taken to complete the sequence

3 Camera records a pilotless plane hurled from platform to haystack. Joining the three films forms a realistic picture. Only part within light broken line appears on film



DIAGRAMS ON BLACKBOARD PREPARE FOR SKY STUNTS



No attempt is made to film thrilling events in the air until the entire program has been carefully worked out with drawings on a blackboard. Pilots must know exactly what they are expected to do when aloft. Above left shows scene desired with plane *B* traveling at greater speed as it swoops upward out of picture with plane *A* following. Blackboard diagram at right shows how plane *B* must attain required additional speed by sharp dive just before entering picture area alongside of *A*. Camera ship *C* travels along parallel to *A* while ship *B* shoots into proper position. Camera starts grinding at that point and continues till ships leave scene

a number. On the screen these numbers appear to possess some military significance, yet primarily they enable the directors to spot planes that may be out of place, and to give new instructions in case retakes become necessary. With costs mounting sometimes at the rate of $3,000 an hour, a single plane out of place may spoil an entire day's work running into uncomfortably large figures.

Weeks and even months of ground preparation precede scenes that appear to the novice to be rather simple. Yet even the most simple air scene is complicated, a mixture of three elements in any of which the slightest miscalculation or slip by a single pilot will require one or more additional flights and the waste of costly time.

Remember, when next you see a thrilling air sequence, these three facts: the camera ship or ships move in only one direction; the background moves in the opposite direction, else the object planes appear to stand still; and the planes to be photographed must fly in the same direction as the camera plane, else they will move quickly out of the camera's range and in a few seconds be only dots in the sky.

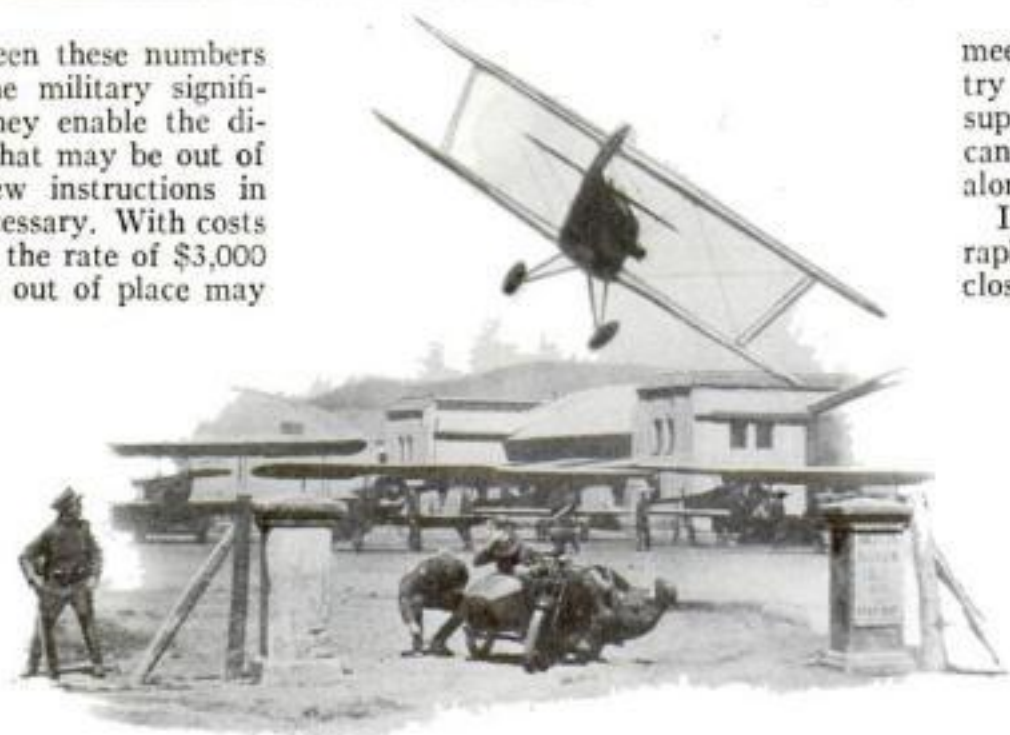
Witness a loop-the-loop. In filming some scenes for a recent picture, Captain E. H. Robinson, former Army bombardment pilot and now one of Hollywood's better known technical directors of air pictures, piloted the camera plane to film three planes looping in formation, a form of air thrill made popular by such famous teams as the Army's "Three Musketeers" and the Navy's "Sea Hawks." The camera registered the first half of the loop as the trio of planes rolled over directly off his right side; but in falling away from the top of the loop, since the planes now were moving in the opposite direction, they showed as mere specks on the screen.

What to do? An experiment was tried. Since the first loop gave a thrilling picture up to the top, when the planes were on their backs, that part of the loop was accepted. To film the second half, Captain Robinson experimented, sending the three pilots through the same maneuver fully fifty times. At last his cameraman successfully recorded the latter half of the formation loop after the three planes dove 200 miles an hour directly in front of the camera plane and looped so as to be on their backs at the top as the camera ship came alongside. The scene finally appearing on the screen was made up of halves of loops number three and forty-seven!

"The loop was only part of the picture," Capt. Robinson explained, as he traced the action on a blackboard at the studio for me. "We photographed the action ten times during the fifty practice runs. At other times the light was inadequate or the background did not meet the director's requirements. I always try to fly one of the camera planes while supervising an air sequence, for I then can see exactly what the camera, fixed alongside the after cockpit, sees."

In another sequence, the aerial photographers were at their wits' ends to film a close-up of a pilot's face as another ship dove on him, missing his plane by inches. This was a real air picture, mind you, and not a studio fake. In order to get the effect of a plane diving in from the rear quarter as the pilot looked back over his shoulder, Captain Robinson resorted to this novel arrangement:

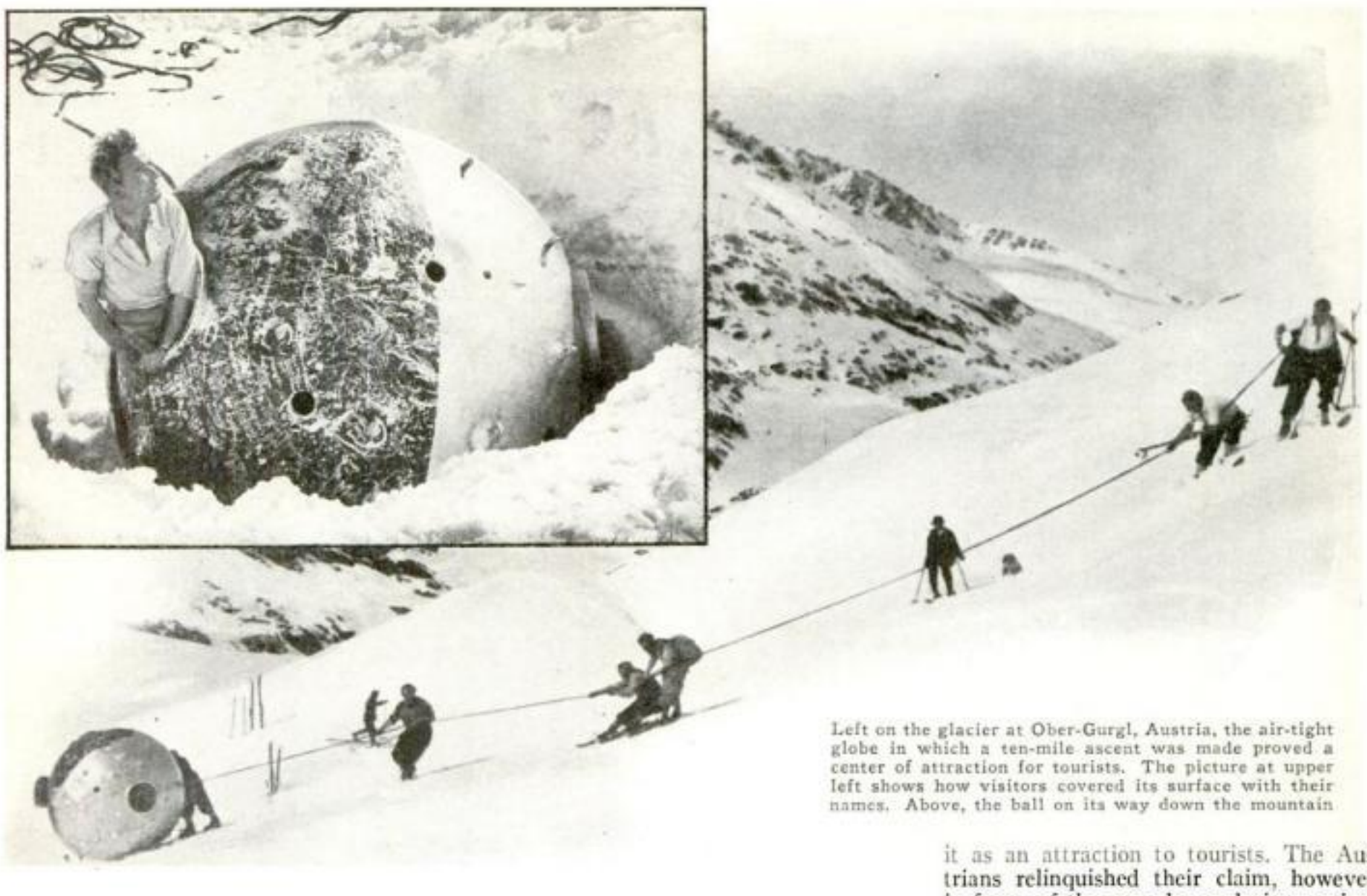
Mounted in the center of the top wing on the plane to be subjected *(Continued on page 112)*



This is a real stunt in which the pilot dropped his ship within five feet of the ground at the airport before he rose again

Battery of cameras set up on ground to film air scenes. Usually, however, aerial pictures are all taken from camera plane

Save Air-Tight Globe for Second Flight into Stratosphere



Left on the glacier at Ober-Gurgl, Austria, the air-tight globe in which a ten-mile ascent was made proved a center of attraction for tourists. The picture at upper left shows how visitors covered its surface with their names. Above, the ball on its way down the mountain

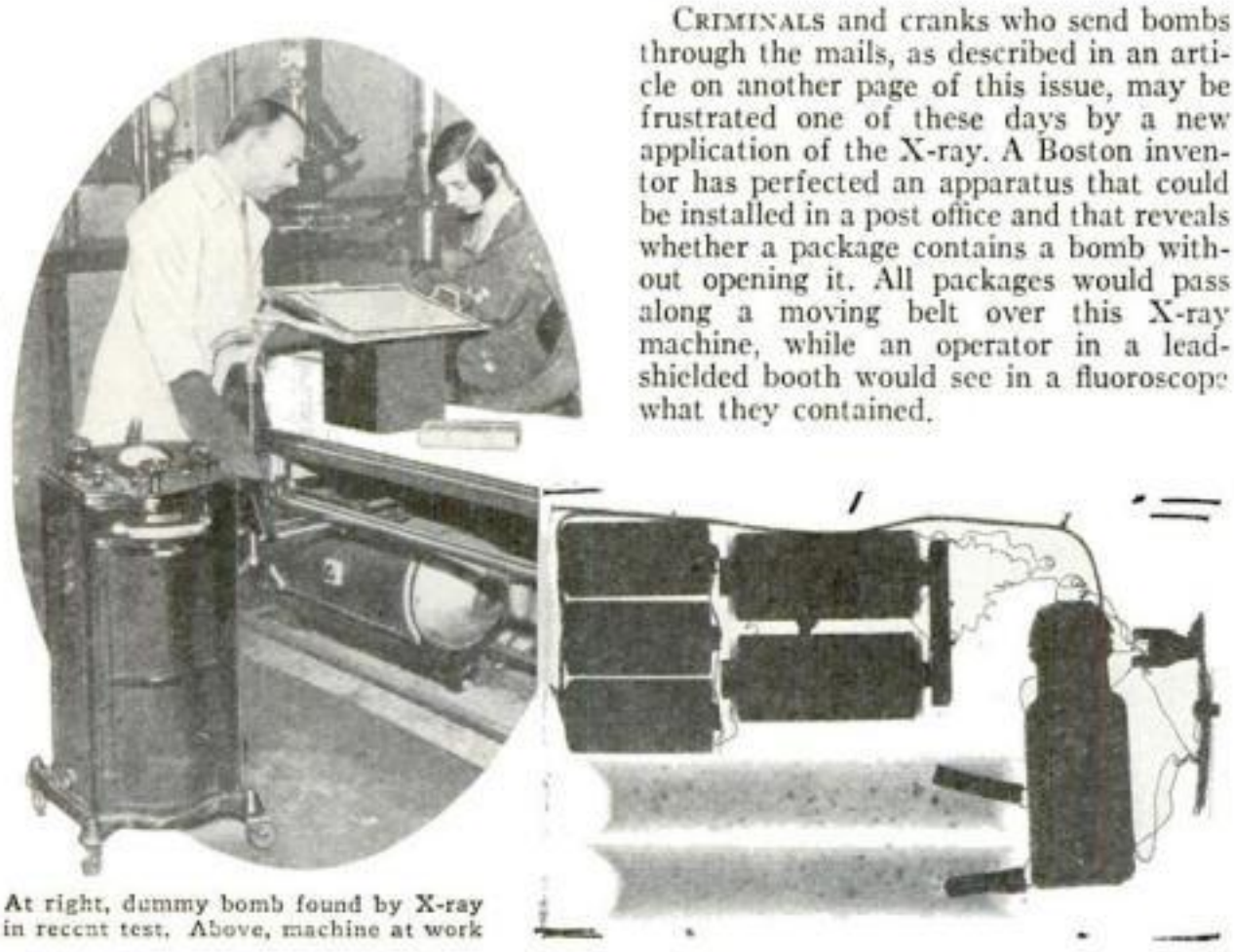
ONE of the strangest of vehicles—the air-tight aluminum ball in which Prof. Auguste Piccard and a companion sealed themselves and, swung from an enormous balloon, soared from Augsberg, Germany, to a new height record of ten miles above the earth—has been removed from its resting place on a glacier at Ober-Gurgl, Austria. It will be taken to Brussels for a forthcoming attempt to ascend even higher.

This action ends a friendly dispute of a year's standing between two nations as to the ownership of the ball. Belgium claimed it as the country of its origin, while Austrian residents of the glacier town where it came down from the sky hoped to retain it as an attraction to tourists. The Austrians relinquished their claim, however, in favor of the new sky exploring project, since there was no other ball available in the world exactly like it.

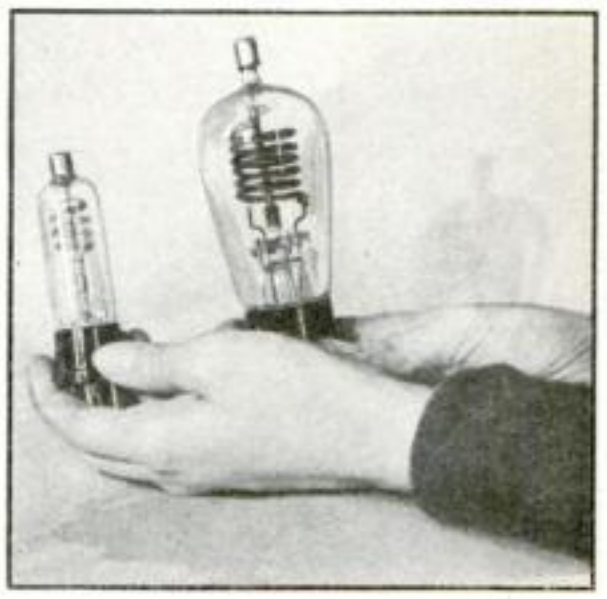
A ball of this construction is necessary for flights into the stratosphere because at a height of ten miles above the earth the air is so thin that there is insufficient oxygen to breathe, and air pressure is so dangerously low that the unprotected human frame could not endure it.

USE X-RAYS TO FIND HIDDEN BOMBS

CRIMINALS and cranks who send bombs through the mails, as described in an article on another page of this issue, may be frustrated one of these days by a new application of the X-ray. A Boston inventor has perfected an apparatus that could be installed in a post office and that reveals whether a package contains a bomb without opening it. All packages would pass along a moving belt over this X-ray machine, while an operator in a lead-shielded booth would see in a fluoroscope what they contained.



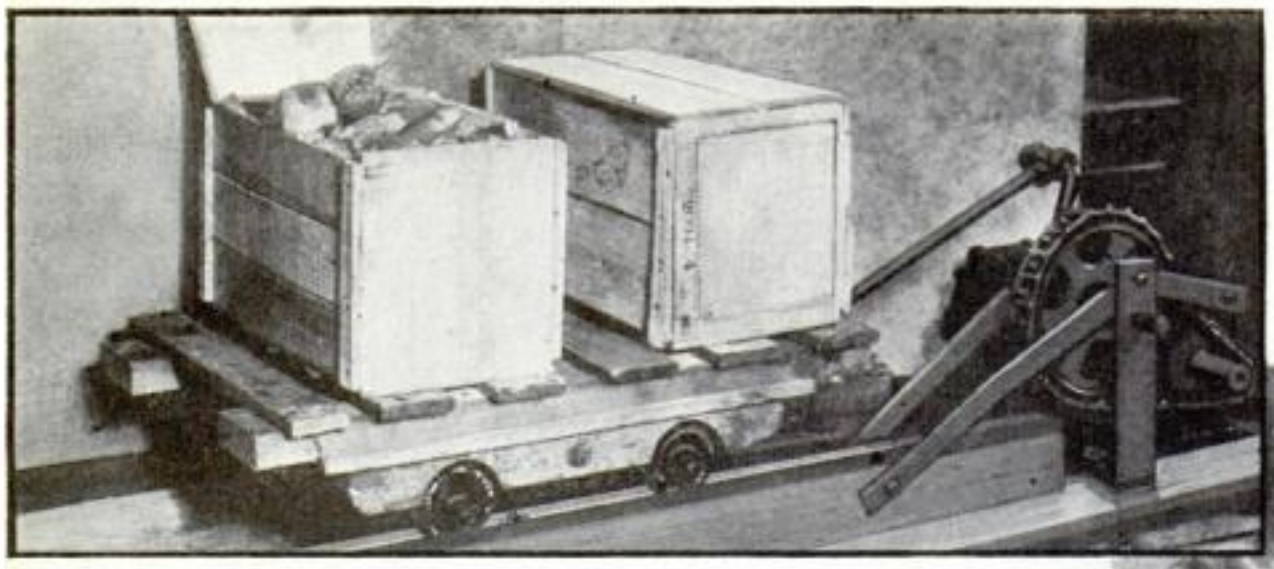
At right, dummy bomb found by X-ray in recent test. Above, machine at work



NEW TUBE HAS GIANT ELECTRIC RESISTANCE

ENGINEERS solved an unusual problem recently when resistance devices of exceptional magnitude were required for studies of photo-electric cells. Dr. Harvey C. Rentschler, director of research of the Westinghouse Lamp Company, has produced reliable resistors of 235,000,000,000 ohms by sputtering a thin film of carbon on a glass helix in a bulb. A windowpane might transmit more current.

APPLES IN CRATES WELL JOLTED IN PACKING TESTS



Packed in crates, these apples were subjected to heavy jolting on an experimental truck by the Department of Agriculture to find better ways of packing

Test showed spots on apples were due to bad packing and that cardboard saved the fruit

IMPROVEMENTS in methods of packing apples have been discovered at the Arlington, Va., experimental farm of the United States Department of Agriculture. An imitation truck driven backward and forward by machinery simulated the shaking the fruit would receive on a long truck or car journey. Examination of crates of apples thus given a synthetic ride showed that irregularities and spots in the fruit were the result of faulty packing methods. Cardboard liners in the crates, it was found, did much to protect the fruit from injury on long journeys.

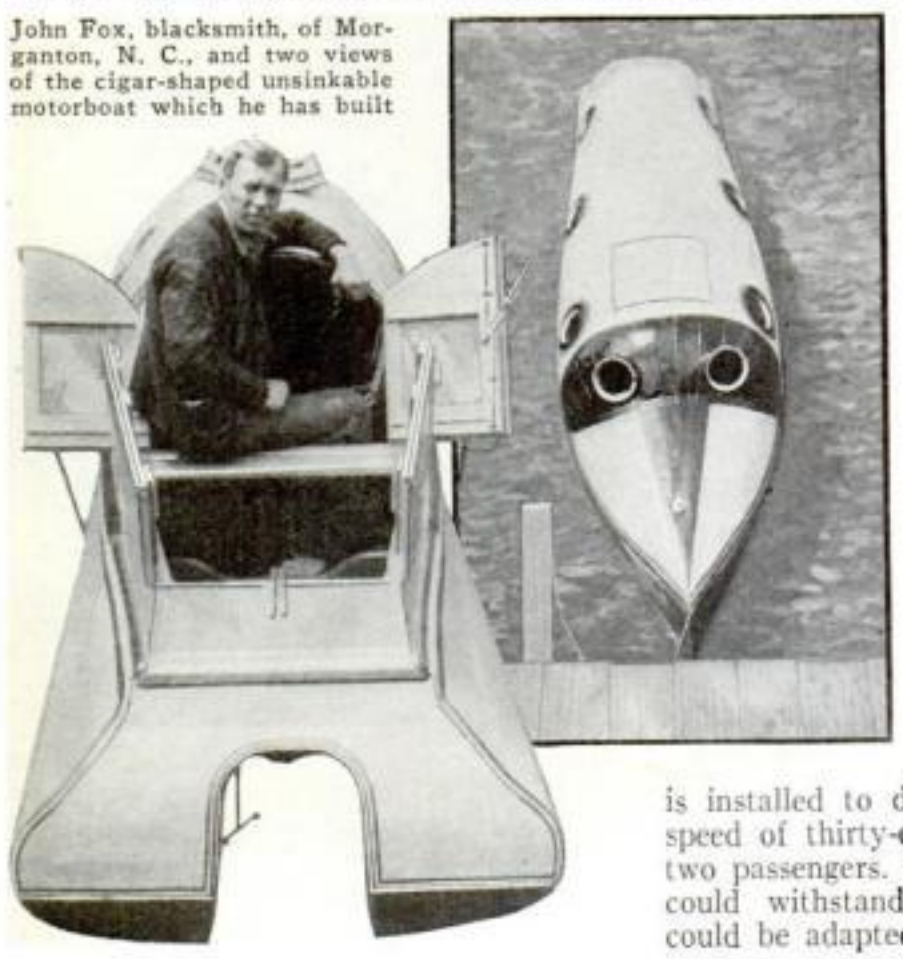
A portable ultra-violet ray machine that finds art fakes

NEW RAY OUTFIT FINDS ART FAKES

ULTRA-VIOLET rays in recent years have proved their value to detect forgeries in paintings, and a new portable apparatus developed in England makes their application to a suspected work of art an easy matter. This instrument, resembling a camera in appearance, is the invention of Prof. A. P. Laurie of the Royal Academy of Arts. It is conveniently carried to the point of use, and under its telltale rays it is possible to see details of technique and materials not visible to the unaided eye.

CIGAR-SHAPED MOTORBOAT CAN'T SINK

John Fox, blacksmith, of Morganton, N. C., and two views of the cigar-shaped unsinkable motorboat which he has built



WITHOUT the aid of previous experience to guide him, a Morganton, N. C., blacksmith has fulfilled a lifetime dream by designing and building himself a seagoing motorboat. Startlingly unconventional in appearance, the cigar-shaped craft is especially suited for rough water, and its builder, John Fox, contends that it could even roll over like a barrel without sinking. The passengers may fish from the open platform at the stern, or retire into the watertight cabin in stormy weather. A ninety-three-horsepower motor is installed to drive the odd craft at a speed of thirty-eight miles an hour with two passengers. Fox asserts his odd boat could withstand an ocean voyage and could be adapted for fishing trips.

TALKS AT CONFERENCES RECORDED IN STEEL

ALL that happens at business conferences may now be permanently recorded by a recently developed electrical system. Upon the table in front of each one present is placed a microphone. The chairman, pressing the proper buttons, switches on the "mike" before the speaker, whose voice is recorded by a dictating machine upon a length of steel wire which may be played back at any time.

STAMP INKS ITSELF

A DATE stamp devised by a California inventor requires no ink pad, because it reinks itself. The ink is carried in a narrow pad on a hinged arm, which protects the characters and swings out of way when in use.

CASH PRIZE WINNERS

Twenty-nine Who Proved Successful Showed Surprising Skill in Presenting Their Entries in Our

APRIL Heroes of Science CONTEST

CHECKS to a total of $1,000 have been sent by POPULAR SCIENCE MONTHLY to the twenty-nine winners in our April Heroes of Science Picture Cut-Out Contest, whose names appear on this page. The winners in the March contest were announced last month (P.S.M., June '32, p. 31).

So far fifty-eight readers of this magazine have won $2,000 in cash prizes, ranging from $500 to $10. They won these awards not by chance, for luck plays no part in this game, but through their own initiative, patience, and skill.

Their success should serve as an incentive to those who as yet have not entered the contest; and to those who have failed to win a prize. Everybody has the same chance to appear in one of these lists of winners. To participate in the contests and to win a prize, no special knowledge or experience is required.

There is plenty of opportunity to have another try, or to begin competing if this contest is new to you. The June contest does not close until June 30. Details of the July competition, which will run until July 31, will be found on the next two pages of this issue.

In addition, the contest for the Grand Prizes, which will be awarded at the close of the monthly contests, will be open to everyone, whether he has won a prize in the monthly contests or not. There will be seventy-one Grand Prizes, totaling $4,000, and ranging from $2,000 to $10. How to win one of the Grand Prizes also is explained on pages 32 and 33.

The chance to be paid $2,000 for a few evenings' good fun does not come your way every day. As this is written, nobody knows who the fortunate winner of the $2,000 Grand Prize will be. Why should it not be you? Try for it!

FIRST PRIZE . . . $500

T. L. Kellett, ***Livermore, Calif.***

SECOND PRIZE $100

M. L. Clark
Portsmouth, Ohio

THIRD PRIZE $50

George Carnevale
South Ozone Park, N. Y.

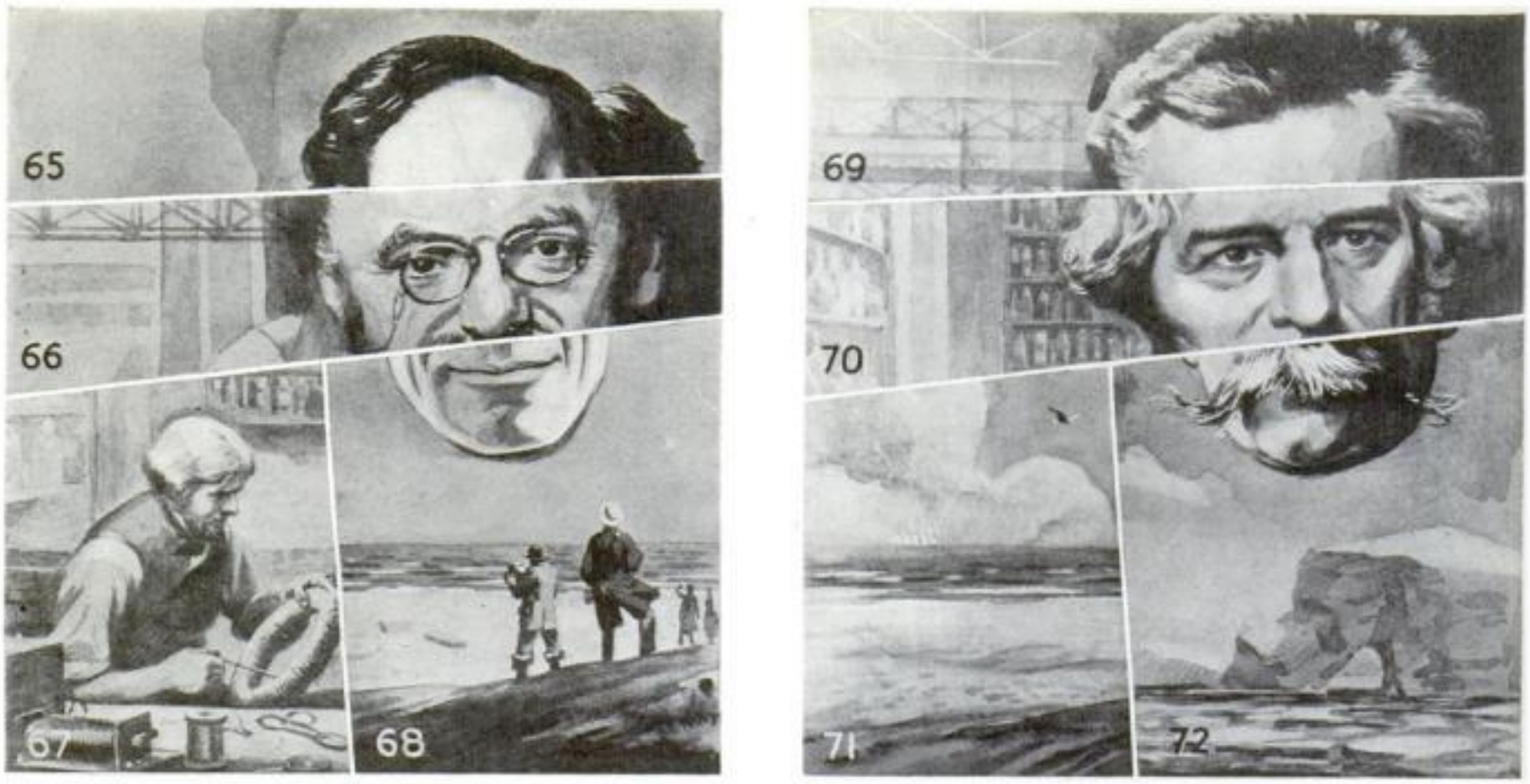
SIX $25 PRIZES

H. J. Aschenthrop, *St. Louis, Mo.*
Gerald Damush, *Brooklyn, N. Y.*
Margaret Howell, *Clarendon, Va.*
K. R. Kimmerly, *Watertown, N. Y.*
W. Norman Krell, *Ft. Worth, Tex.*
Robert North, *Glenbrook, Conn.*

TWENTY $10 PRIZES

O. B. Allen, *Evansville, Ind.*
Fred Beaumont, *New Bedford, Mass.*
Emily C. Boekell, *New York City.*
Joseph Bosanic, *Milwaukee, Wis.*
Ralph Clark, *Milwaukee, Wis.*
J. A. Davis, *St. Helena, Calif.*
Charles Delmont, *New York City.*
David Felzer, *Waukegan, Ill.*
Robert Flemming, *New York City.*
Norman Goldberg, *Racine, Wis.*
Mona Grammer, *Willowbrook, Calif.*
M. E. Hayhurst, *Columbus, Ohio.*
Eleanor Herre, *Wolcott, N. Y.*
Laurence Lambiase, *Brooklyn, N. Y.*
H. Day Lowry, *Richmond, Va.*
Andrew Mazur, *Monessen, Pa.*
Ethel Millspaugh, *Anderson, Ind.*
Walter Quest, *Nashville, Tenn.*
A. R. Renslow, *Minneapolis, Minn.*
Charles Sharpe, *Los Angeles, Calif.*

¶ *YOU May Win a Prize by Entering Our Fascinating Picture Cutting Contest* . . . SEE TWO FOLLOWING PAGES



Cut out these pictures along white lines and you will find it easy to put eight parts together to make two pictures.

$10,000 *in* CASH

Here Are Two More Heroes of Science

ARE you dreaming about a trip to Europe, a new car, or an important renovation or addition to your house? The sum of $500 could make any of these or many another dream come true. You may earn that amount in one evening, and at the same time thoroughly enjoy yourself, by participating in our fascinating Heroes of Science Contest.

On page 31 of this issue, you will find the names of the twenty-nine contestants who won $1,000 in cash prizes in April. You stand exactly the same chance to capture one of these generous cash awards. This month again, POPULAR SCIENCE MONTHLY will distribute $1,000 in twenty-nine cash prizes, ranging from $500 to $10, among the winners of the current contest. You need not have entered any of the previous contests to compete in this one.

Besides, there are many more prizes in store for our contestants. At the close of the monthly contests, in August, seventy-one Grand Prizes totaling $4,000 and ranging from $2,000 to $10 will be awarded.

You need not be a hero of science yourself to compete and win in this entertaining and instructive game. You need not be an expert in any field. All you need is to be alert! You will find, at the top of these pages, four composite pictures, representing Heroes of Science and Their Accomplishments. Each of these pictures is divided into four parts, sixteen parts in all. Each part belongs in a different picture. If you cut out the parts, and reassemble them correctly, eight of them will give you TWO COMPLETE PICTURES of Heroes of Science, with eight parts left over.

To help you in the assembling job, we give you some clues to the identity of the heroes and the nature of the accomplishments that have made them internationally famous. It is up to you to use these hints to best advantage. If you do, you will find solving the puzzles no difficult task.

Monthly prizes will be awarded to those contestants who submit the two correct complete pictures, assemble and mount them in the neatest and most skillful manner, and state the name and accomplishment of each of the two Heroes of Science in twenty words or less.

How about the eight left-over cuttings? BE SURE TO KEEP THESE CAREFULLY after you have assembled the two complete pictures and sent them in to compete for the monthly prizes. Provided you have preserved the left-over clippings from the beginning of the contest, these extra cut-outs will give you TWELVE ADDITIONAL COMPLETE PICTURES of Heroes of Science. Contestants must keep the left-over cuttings throughout the six months of the contest, and the additional TWELVE PICTURES must not be sent in until the close of the contest, when Grand Prizes will be awarded.

In competing for the monthly prizes, submit only TWO COMPLETE PICTURES, in which no left-over cuttings are used. The two complete pictures you send in this month must be assembled from the cuttings numbered from 65 to 80 inclusive.

It is not necessary to be a subscriber or regular reader of POPULAR SCIENCE MONTHLY to compete in this contest. Neither is it necessary to buy the magazine. A copy may be borrowed from a friend, or you may consult the current or the four previous issues at the public library or any office of POPULAR SCIENCE MONTHLY and copy or trace the pictures. It is permissible to get all the help you need from members of your family, friends, or neighbors.

The competition is open to everybody, everywhere, and young and old alike can play the game with pleasure and profit. Try your skill! But before starting work on this month's puzzle pictures, make it a point to read carefully the rules of the contest printed on the next page.

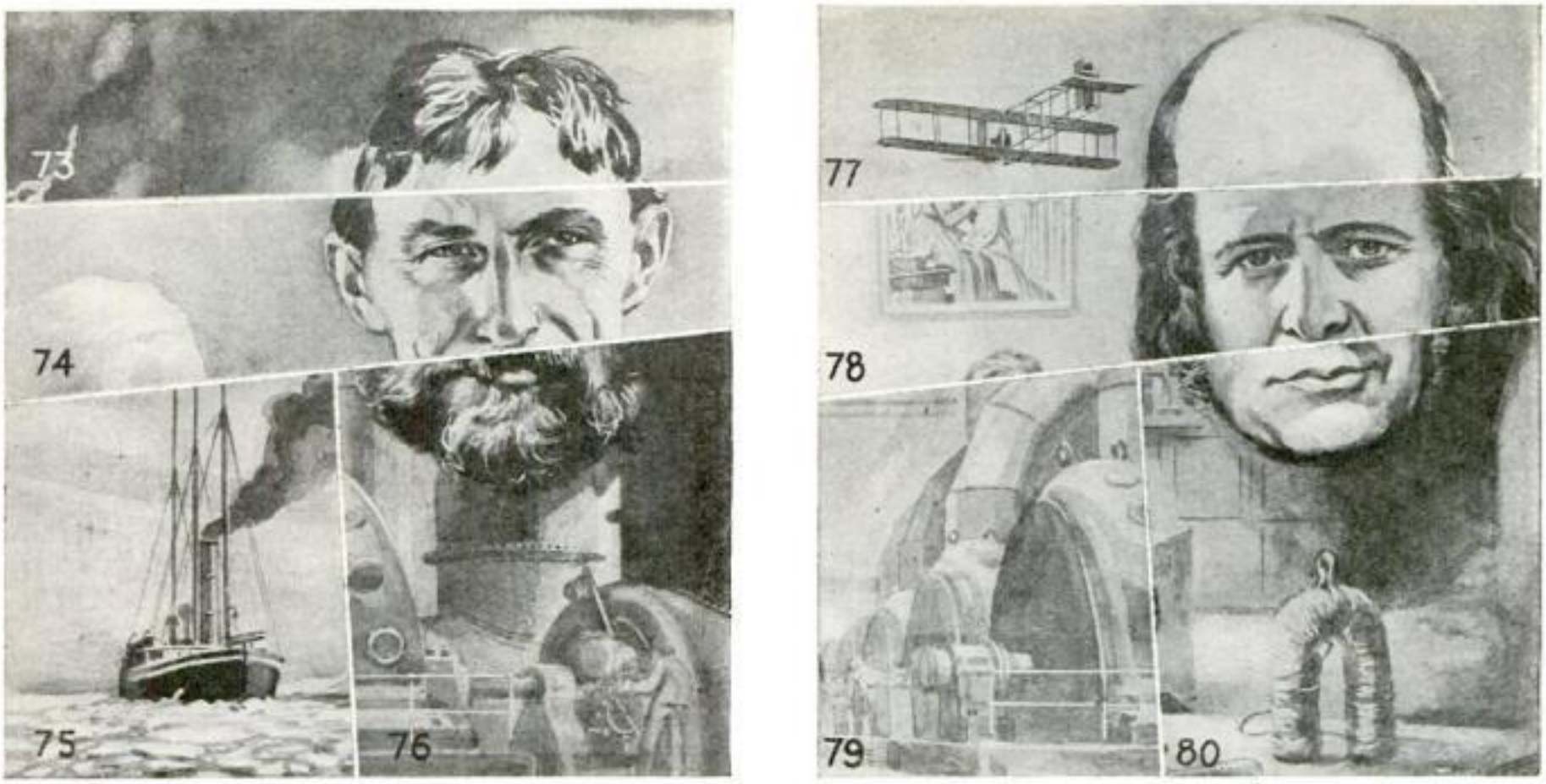
MONTHLY PRIZES

First Prize	$500
Second Prize	100
Third Prize	50
Six Prizes, $25 Each	150
Twenty Prizes, $10 Each	200
Total	$1,000

GRAND PRIZES

First Prize	$2,000
Second Prize	500
Third Prize	200
Three Prizes, $100 Each	300
Five Prizes, $50 Each	250
Ten Prizes, $25 Each	250
Fifty Prizes, $10 Each	500
Total	$4,000

Turn to Page 31 for Names of the April Prize Winners



Eight parts will be left over. Save these carefully to use in making pictures for the Grand Prize Contest

PRIZES FOR SOLVING NEW AND EASY PICTURE PUZZLES

Faraday, whose genius ushered in the present electric age

Steinmetz, wonder-worker in development of electricity

Admiral Peary, famous explorer, discovered North Pole

Byrd, explorer of a new continent in the wild Antarctic zone

Lindbergh, lone eagle of pioneer flight across ocean

Wilbur Wright; with his brother he invented airplane

The Men Whose Pictures Can Be Completed Are in Above Group

Rules of the Contest—Read Carefully

1. Each month, for six months, beginning with March, POPULAR SCIENCE MONTHLY is printing four composite pictures of Heroes of Science and Their Accomplishments. Each set of pictures, when cut apart and assembled correctly, will make two complete pictures with eight parts left over.

2. The pictures must be pasted together. The monthly prizes will be awarded to those contestants who assemble the pictures correctly and in the neatest and most skillful manner. Each of the two complete pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the last day of the month following the date of publication of the magazine in which the pictures appear. Thus, solutions of the puzzle in this month's issue must be mailed or delivered not later than July 31.

4. At the close of the six monthly contests, there will be a final contest for Grand Prizes. To compete for these, contestants must carefully save the cuttings left over from the monthly contests. These left-over cuttings, during the six months, will produce twelve additional complete pictures of Heroes of Science and Their Accomplishments, if assembled in the correct way. These additional pictures must not be submitted during the progress of the monthly contests, but at their close. Entries for the Grand Prize contest must be mailed or delivered not later than the last day of the month following the date of publication of the magazine in which the pictures for the last monthly contest appear. This will be the August issue, published July 2. Entries for the Grand Prize contest, therefore, must be mailed or delivered not later than August 31.

5. To receive consideration for the Grand Prizes, contestants must submit not less than twelve additional complete pictures.

6. Grand Prizes will be awarded to those contestants who assemble the twelve additional pictures correctly and put them together in the neatest and most skillful manner. Each of the twelve pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

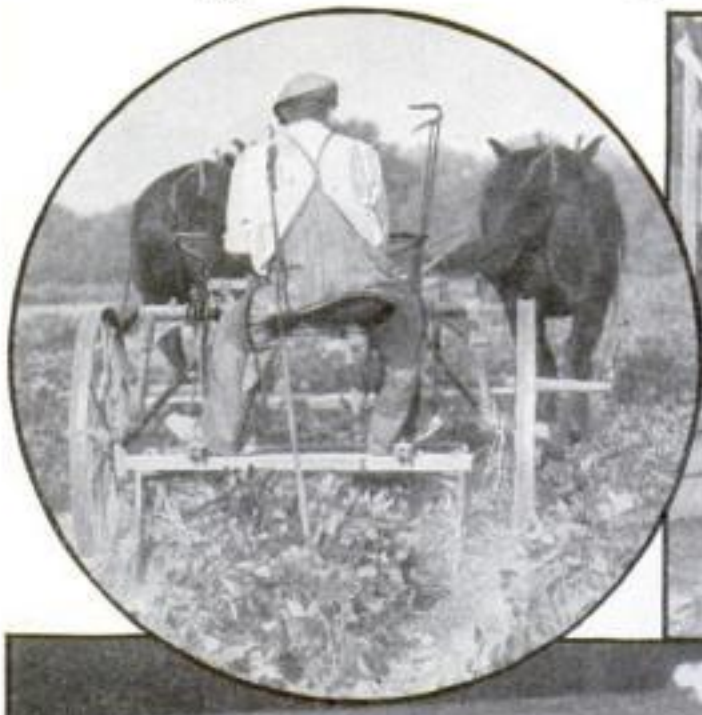
7. In case of ties each tying contestant will be awarded the prize tied for. This rule will be observed in the monthly contests as well as in the Grand Prize contest.

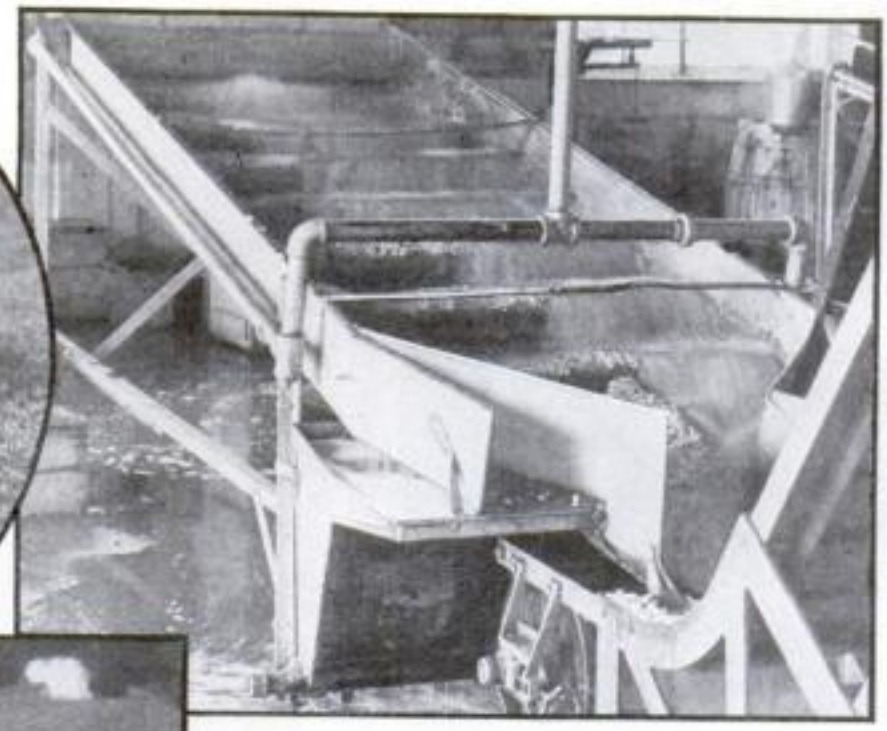
8. All entries should be addressed to the Heroes of Science Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged, and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

9. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend and trace or copy the pictures, or you can examine a copy of the magazine at any office of POPULAR SCIENCE MONTHLY or at the public libraries free of charge.

10. Each contest is open to everybody, everywhere, except employes of POPULAR SCIENCE MONTHLY and the Popular Science Institute and their families. The officials of the Popular Science Institute will act as judges and their decision will be final.

Vegetables Now Quick-Frozen on Farm as Soon as Picked





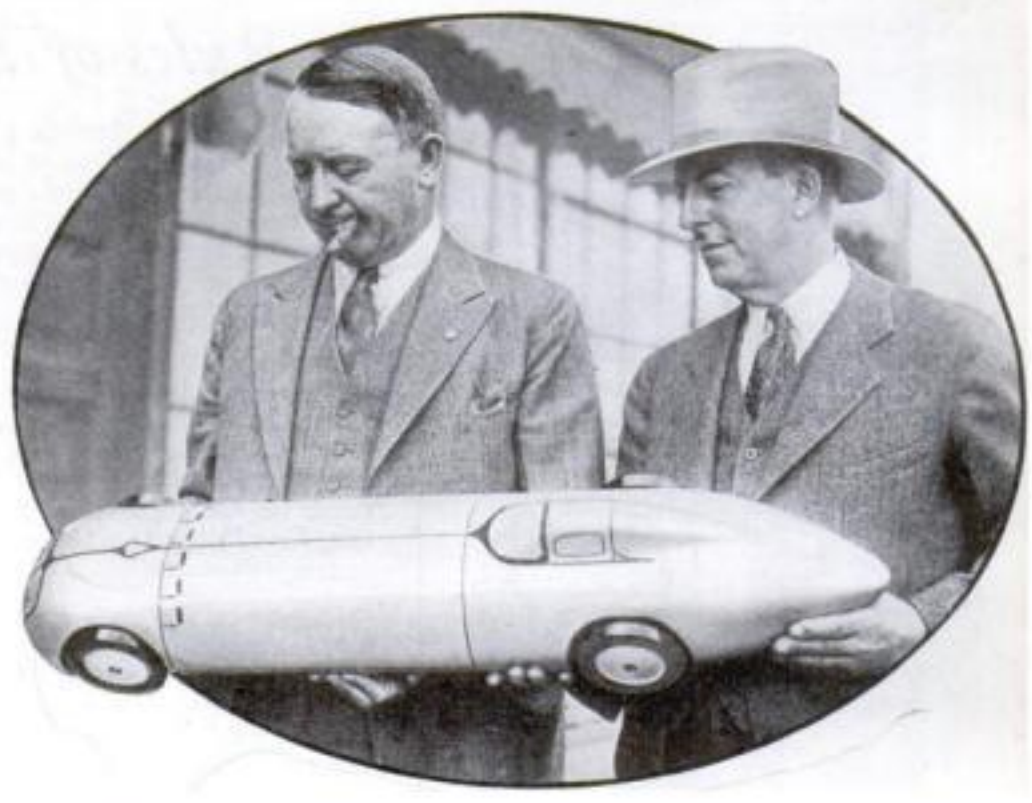
In circle, harvesting lima beans on a New Jersey farm. In this new quantity method, the entire plant is gathered. After swift-working machines have removed the plant growth and shelled the beans, they go through this washing machine, above, and are then ready for freezing. At left, vegetables are packed after being frozen between refrigerated metal plates

So THAT garden vegetables may reach the consumer as fresh as the moment they were picked, a new application has been made of "quick freezing." In this process, perishable food is harmlessly frozen and packaged for refrigerated shipment. Formerly it had to be taken to a factory for the treatment, but now even this trip has been eliminated. Portable quick-freezing apparatus has been developed, so that now, when a farmer's crop is purchased, the freezing apparatus is loaded on trucks and taken to his door. The vegetables are then harvested and upon the spot run through high-speed machines that prepare, wash, freeze, and package them, ready for shipment. The frozen foods may be shipped to points twenty-four hours away, in their insulated fiber-board containers, without thawing out. For longer distances, refrigerated trucks and dry-ice containers keep them cold and fresh.

FIGHTS FIRE FROM AUTOGIRO

AN AUTOGIRO airplane proved its effectiveness as a fire-fighting aid during a forest fire in southern New Jersey not long ago. State Fire Warden Col. Leonidas Coyle rode in the plane, holding a two-way conversation by short wave radio with other wardens in a moving automobile below him. From his aerial perch in the cockpit of the windmill plane he was able to obtain an unusual point of vantage, directing ground fire fighters so effectively that the conflagration was soon under control.

NEW CAR AFTER SPEED RECORD

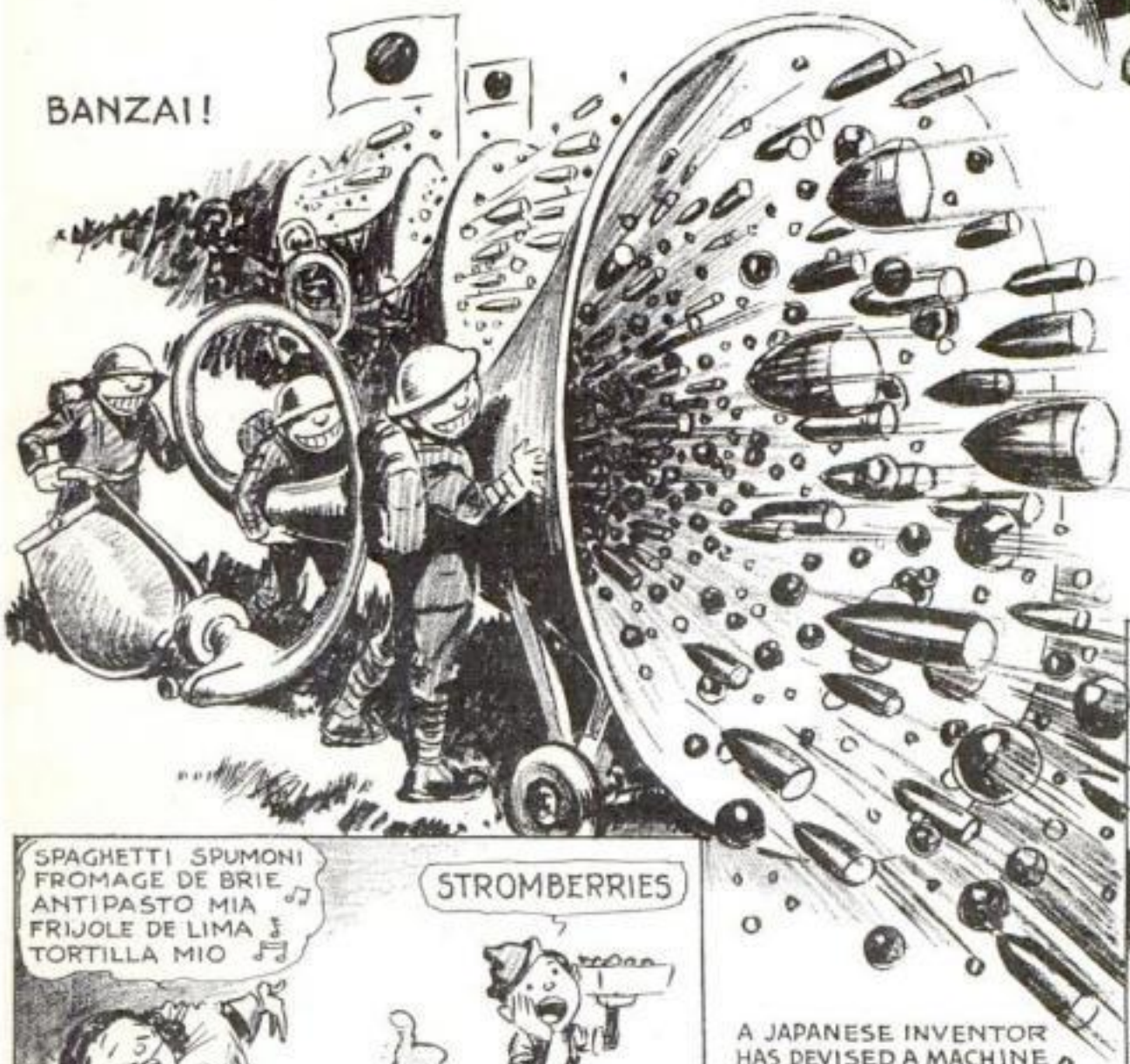


Barney Oldfield, left, famous auto racer, and Harry Miller, noted builder of racing cars, examine a model of the machine in which Oldfield will try to better record of 253 miles an hour now held by Sir Malcolm Campbell

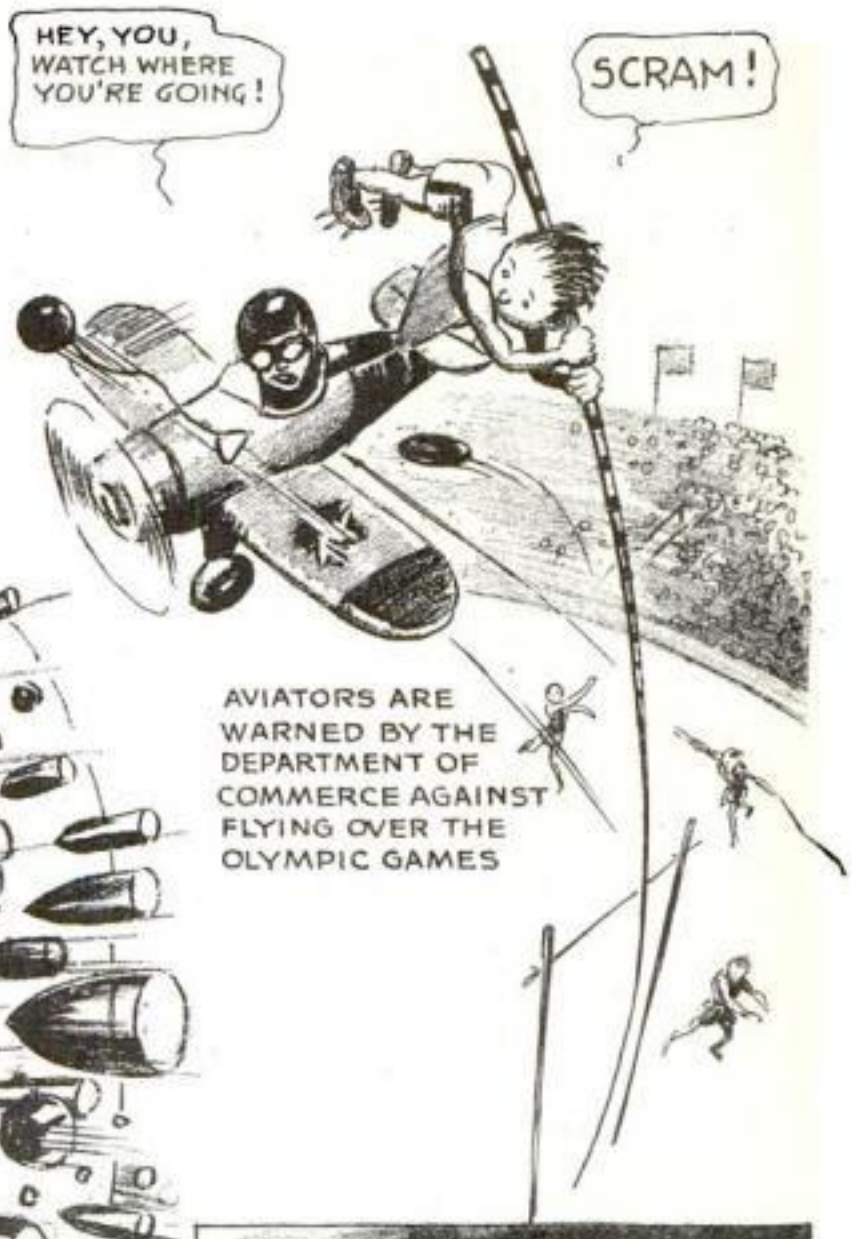
AMERICA will soon try to win back from England the world's speed crown for automobiles. Barney Oldfield, famous racing driver, recently exhibited a model of the three-and-a-half-ton car to be built for this attempt. The twenty-six-foot racer will be driven by a 300-horsepower motor equipped with six magnetos, and Oldfield hopes with it to exceed the 253-mile-an-hour record of Sir Malcolm Campbell, British sportsman, who made that unparalleled speed a few months ago when he drove his car over Florida's sands.

SCIENTIFICKS

...OUR ARTIST VIEWS THE STRANGE AND UNUSUAL FACTS DISCLOSED BY LEADING AUTHORITIES IN THE LAST MONTH



A JAPANESE INVENTOR HAS DEVISED A MACHINE TO STOP AND COLLECT ENEMY BULLETS

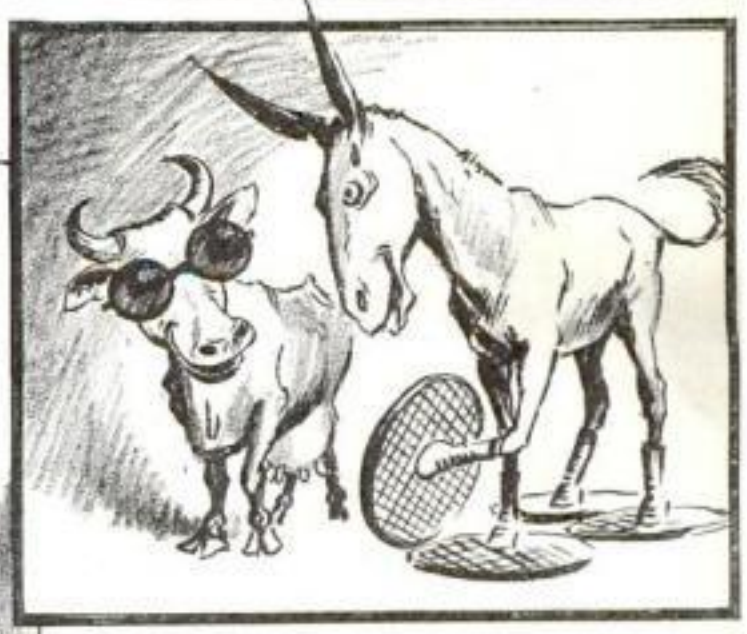


AVIATORS ARE WARNED BY THE DEPARTMENT OF COMMERCE AGAINST FLYING OVER THE OLYMPIC GAMES

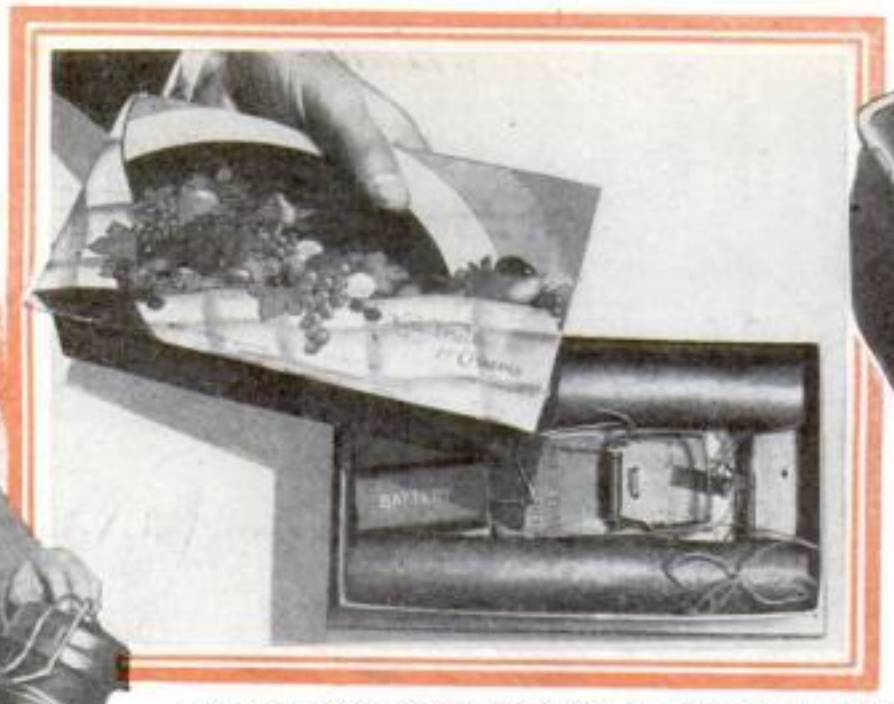
CIGARS MAY NOT BE LABELED "HAVANA" UNLESS ACTUALLY MADE OF CUBAN TOBACCO, THE FEDERAL TRADE COMMISSION HAS RULED

TESTS MADE AT THE METROPOLITAN OPERA HOUSE, NEW YORK, PROVE GRAND OPERA NOISIER THAN CITY STREETS

EXPLOSIONS IN THE BODY CELLS GENERATE HUMAN ENERGY, SAYS DR. GEORGE W. CRILE, FAMOUS CLEVELAND SCIENTIST



SUN GLASSES PROTECT RUSSIAN COWS AGAINST SNOW-BLINDNESS WHILE CANADIAN MULES ARE FITTED WITH SNOWSHOES



WELL-HIDDEN BOMBS. This box of "innocent" candy held a bomb expected to explode as cover was removed. The one in valise was to be detonated by time clock

Oil instead of water is now used in drowning bombs that are found by the police before they go off. The picture shows a recovered bomb being immersed in oil to prevent explosion

How Bomb Sleuths Trap

"Pineapple" Murderers

IT WAS rush hour at the post office. Clerks in shirt sleeves worked at top speed. Loaded hand trucks clattered over the cement floor. Rubber stamps thumped on parcels. Coins clicked. Feet scuffed along the floor as lines of customers fed a steady stream of letters and parcels in at the windows.

At a long table, a clerk was canceling postage on an accumulated pile of packages. Picking up a candy box addressed to the wife of a New York multimillionaire, he brought down his rubber stamp. There was a hollow crunch. The top and end of the box had been smashed in. The surprised clerk peeped inside. He saw two paper-covered cylinders looking like brown Roman candles. They were twin sticks of dynamite powerful enough to shatter the building and blow everyone in it to bits.

Bomb-squad experts hurried to the scene and examined this package of death. They found a small spring mousetrap set so the lifting of the lid would allow the snapper to flop over and hit a copper plate, closing the circuit and detonating the high explosive. Had the lid of the box been entirely shattered, or had it bulged up in the middle, instead of being crushed down, the deadly mechanism would have exploded.

Not so fortunate were half a dozen postal employees at Easton, Pa., early last January, when one of the biggest bomb plots in recent years was uncovered under tragic circumstances.

Two men had shoved six small packages across the counter of the parcel post window, paid insurance and postage, and left. The packages were addressed to prominent citizens throughout the United States. Of identical shape and size, they carried different labels, such as "desk set," "perfume," "clothing." Yet, all the boxes weighed exactly the same.

The receiving clerk was suspicious. After the men left, he cut the string and unwrapped one of the packages. Inside was a white pine box, its lid secured by two metal catches. He slipped back one of the hooks. A blinding white flash filled the room and a shattering blast wrecked the interior of the building, killing two clerks and injuring four others.

Shortly afterwards, another life was added to the toll of this murder plot. Charles V. Weaver, explosives expert from the Du Pont works in Wilmington, Del., volunteered to open the five remaining bombs. Working with a knife at the end of a forty-foot pole, he set about his risky task in a deserted quarry near Easton. He had cut away the wrappings and pried off the lid of one box and was at work on another when it exploded with a terrific blast, injuring him so severely that he died twenty-four hours later.

While the Easton tragedy was taking place, five additional bombs of the same make were rushing by train to other addresses. They had been sent by express. Just in time a warning was broadcast. Recipients turned the mysterious packages over to the police. At Cleveland, Ohio, one received by the Italian consul was carried to an open field. When it was exploded with a rifle shot it tore a hole in the ground thirty feet in diameter.

The box Weaver successfully opened showed the bombs contained two pounds of dynamite pulp impregnated with nitroglycerin. If the hook of either catch were moved to open the box, an electric circuit was closed, setting off the bomb.

PRYING into the secrets of such death machines is the hair-raising work of bomb-squad sleuths. When a bomb explodes, the clues it may contain are destroyed. It is the job of these detectives to open bombs without setting them off and to search inside for evidence that may lead to the capture of the fiendish senders. Their work is: (1) to protect lives, and (2) to obtain evidence to convict the bombers.

Lieut. Charles E. J. Newman, head of the New York Police Department bomb squad, and other experts on high explosives, recently told me how these men go about their perilous business.

Even before you turn the knob to enter the basement room that forms the New York bomb-squad headquarters, you learn something interesting about the men inside. They can't be superstitious, for the number on the door is 131 Against the brown-painted wall, back of Lieut. Newman's desk, is a locked cabinet. Through the glass doors, you see fragments of

DEATH-DEALING "FRUIT"

Here are two forms of the "pineapple" bomb which has come into high favor with crooks in late years. They are detonated with time fuses

HUNTING *Clues in Dynamite Attacks Is Extra-Hazardous Business and This Article Tells of Tragedies with Deadly Machines*

By EDWIN W. TEALE

One bomb, planted on the porch of this house, demolished the front of the building and killed three of the inmates

CAR STARTER WHIRLS AND BLAST FOLLOWS

The bomb above is designed to be attached to the starter and chassis of a car and is ignited when the foot presses down the starter lever. At the left, an automobile that was wrecked by such a bomb

exploded bombs, models of famous infernal machines, small bottles labeled "Prussic Acid," "Gun Cotton," "Dynamite," "T.N.T.," and discolored fuses that figured in the activities of dynamite gangs of the past.

In a far corner of the room is a big green filing case. It holds photostatic copies of more than a thousand anonymous threat letters, which are compared, in a search for clues, with notes received before bombings. They are filed according to language, writing, and the underworld symbol found at the end. The symbols most frequently found are crudely drawn crosses, black hands, daggers, and caskets. Others are skulls with crossbones, guns, hearts, blackjacks, "pineapples" and lighted sticks of dynamite. The system of filing copies of all threat letters as an aid to the work of the bomb squad is an innovation that was started last year.

The most common type of bomb found today, I was told, is known in the underworld as a "loving cup." It is a section of iron pipe, capped at both ends and filled with dynamite. Either a lighted fuse or an electrical connection sets it off. In several cases, such a bomb has been hooked to the lighting system in a victim's house so it exploded the instant he switched on the lights.

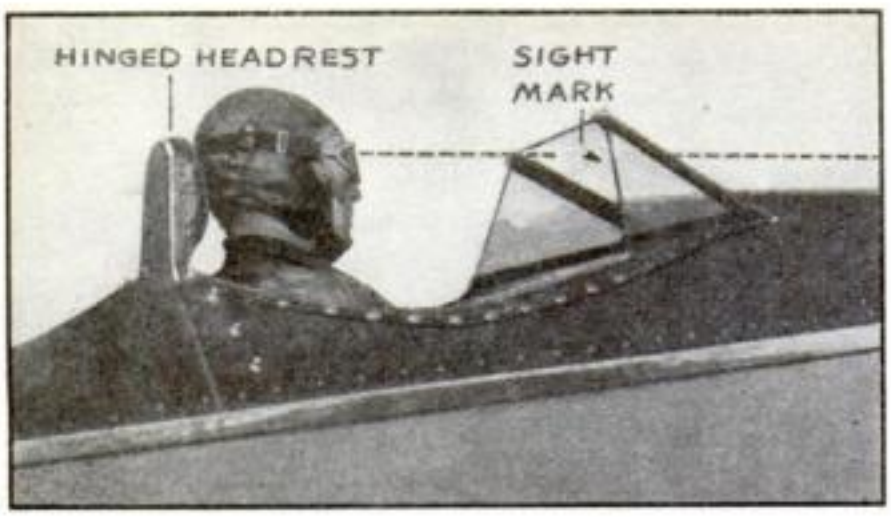
Formerly one of the first things done when a bomb was found was to "drown" it in water. In powder bombs, this dampened the explosive so it would not ignite. In an electrical mechanism, such as the Easton packages, however, water would cause a short circuit, and detonate the high explosive.

This is what happened in Milwaukee, Wis. An infernal machine that had been immersed in a tub of water at police headquarters exploded, wrecking the building and killing fourteen officers.

Oil instead of water is now used in drowning bombs. Then, if they contain electrical detonators, a short circuit will not set them off. Also, the oil soaks into the fulminate of mercury caps and prevents them from igniting.

Another reason why bombs are now never placed in water is because calcium phosphide is present in some explosives. When water strikes it, phosphine gas is formed. The instant this gas reaches air, it bursts into flame and may set off the bomb.

Most people think that time bombs are set off by clockwork mechanisms. While such death machines were responsible for snuffing out twenty-one lives in the *Los Angeles Times* in 1910 and killing thirty-three people in the Wall Street blast of 1920, they are relatively rare. As a matter of fact, I was told, only one clock bomb has been found in the vicinity of New York in the last five years. Chemical or fuse timing devices are most frequently employed. *(Continued on page 110)*



PILOT CAN AIM PLANE AT TARGET

AIMING an airplane at a gunnery target is made easier by new equipment designed by Major Gerald E. Brower, U. S. Army Air Corps. A hinged flap immediately behind the pilot's head is raised when the guns are about to be fired and holds the pilot's head central with the ship. His eyes are focused on a small mark on the windshield, fixed accurately on the plane's fore-and-aft center line.

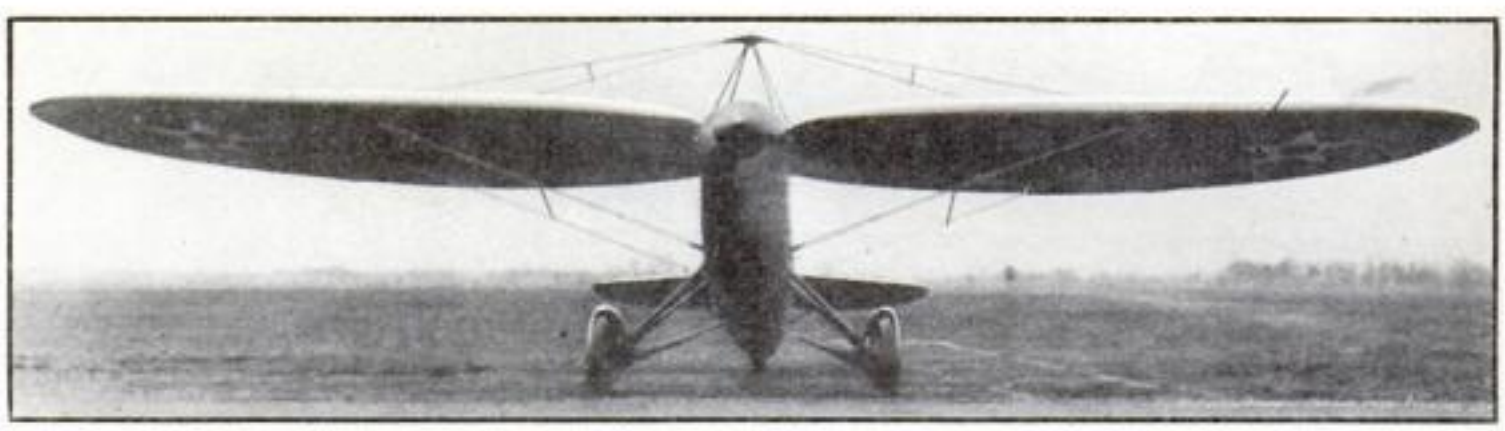
FLYER WEARS LIGHTS IN JUMP

ABLAZE with light from a ring of lamps strapped around his waist, a parachute jumper recently dropped at a Burbank, Calif., airport. The human firefly was Royce Stetson, veteran transport pilot, who sought to test his idea that objects fall faster at night than in the daytime. Observers watching through telescopes timed the speed of his fall before he opened his 'chute. First results seemed to verify his theory, although the difference in speed might be caused by errors in observation.

Flyer with lights worn in falling speed test

ARMY PLANE A "BUTTERFLY"

A HIGH-FLYING speedster is the U. S. Army's newest type of observation airplane, whose wings suggest those of a butterfly. Its 650-horsepower motor drives it at a speed of 190 miles an hour at an elevation of 5,000 feet.



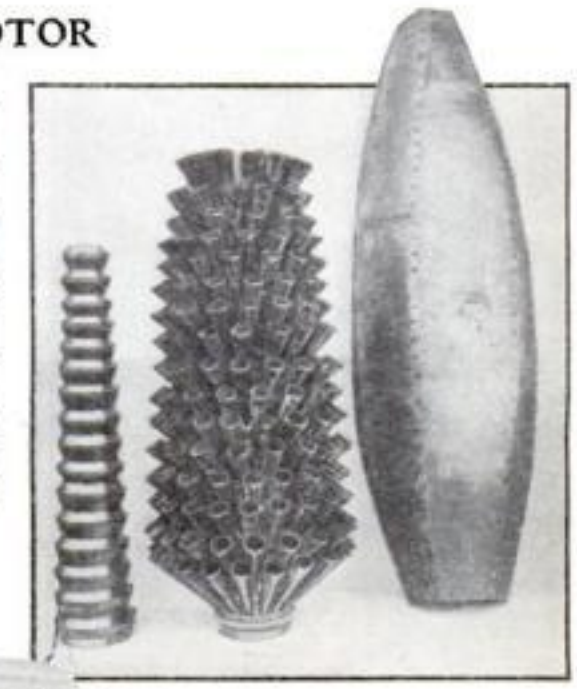
High-flying swift plane with butterfly wings designed for the Army. First of six such planes ordered

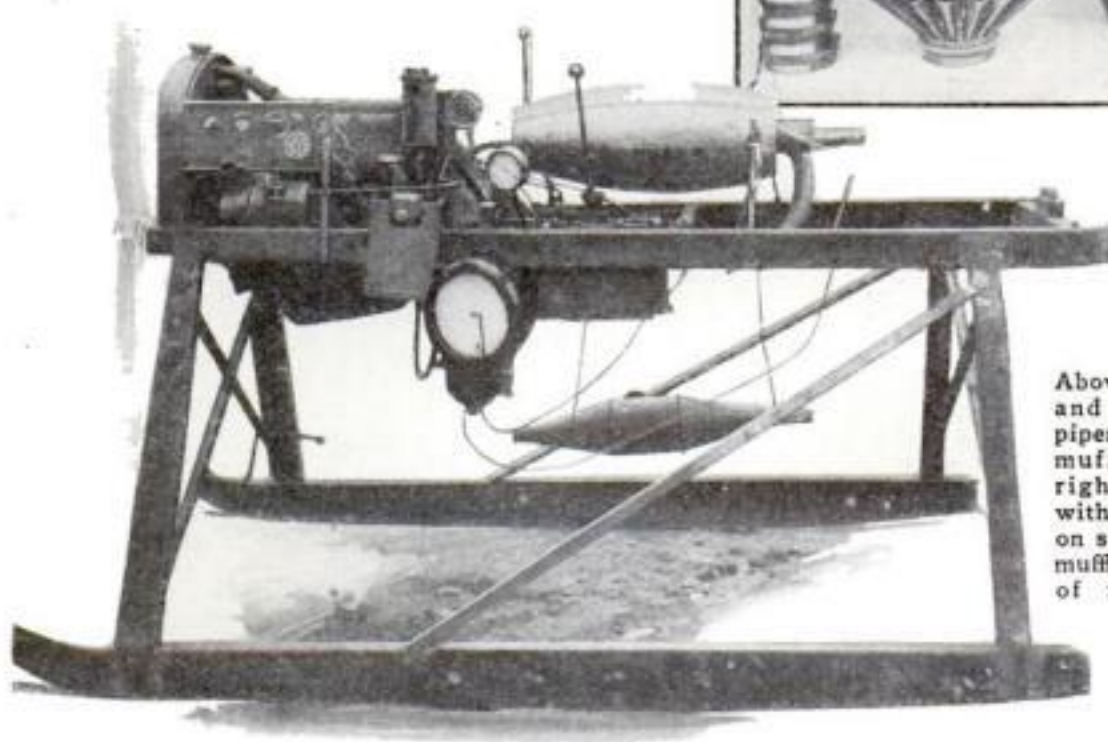
AIR CAMERA CAN TAKE CLOSE OR FAR VIEW

CLOSE-UPS or far shots of the land beneath an airplane can now be made with the same camera, regardless of the plane's altitude, by use of a new device called a "zoom lens." An interconnected series of lens elements permits changing the magnifying power of the lens while in flight without making the pictures fuzzy. With it close-up views can be made of a parachute jumper all the way down. It is expected to be especially useful in military work.

MUFFLER QUIETS PLANE'S MOTOR

A CLUSTER of pipes resembling the branching spikes of a flowering shrub occupies the interior of a novel muffler for airplanes, designed by a Ware, Mass., inventor. So effectively does it operate that all but seven percent of the original engine noise is said to be removed. In a test to determine whether it would introduce a fire hazard, a bottle of high-test gasoline was poured over the muffler while the engine was running. The gasoline was not ignited. For the acoustic tests, the muffler was mounted with an engine on a test stand and the sounds picked up by a microphone.





Above, the tube and rosette of pipes fit inside the muffler case at right. Mounted with an engine on stand, left, the muffler killed most of motor noise

BIG MODEL PLANE MAKES LONG FLIGHT

ONE of the biggest model airplanes ever built made a successful test flight recently at Pasadena, Calif. Powered by a two-cylinder gasoline motor, the plane took off with preset controls and flew for several hundred yards. Its wing spread measures ten feet, and the model carries a one-pint tank for gasoline. It was designed and built by the aviation club of Washington Junior High School, Pasadena, and represents a year's work in drafting rooms and shop. The students also built the engine, which drives the model plane at forty miles an hour. On its initial flight the model craft took off within less than fifty feet and attained an altitude of more than 100 feet.

Right, turning over the two-cylinder engine that powers this model plane with ten-foot wing span. Above, plane on long test flight

GLIDER PILOTS ATTEMPT TO BURST BALLOONS

SKIMMING above a mile-long hillside, near Los Angeles, Calif., glider pilots recently jockeyed their motorless planes in a spectacular balloon-bursting contest. Armed with pin-pointed lances, they were shot into the air at the top of the slope, while balloons were held high in the air at the bottom of the hill. The glider pilot who punctured the most balloons won.

BRITISH PLANE DROPS BOMBS AND TORPEDOES

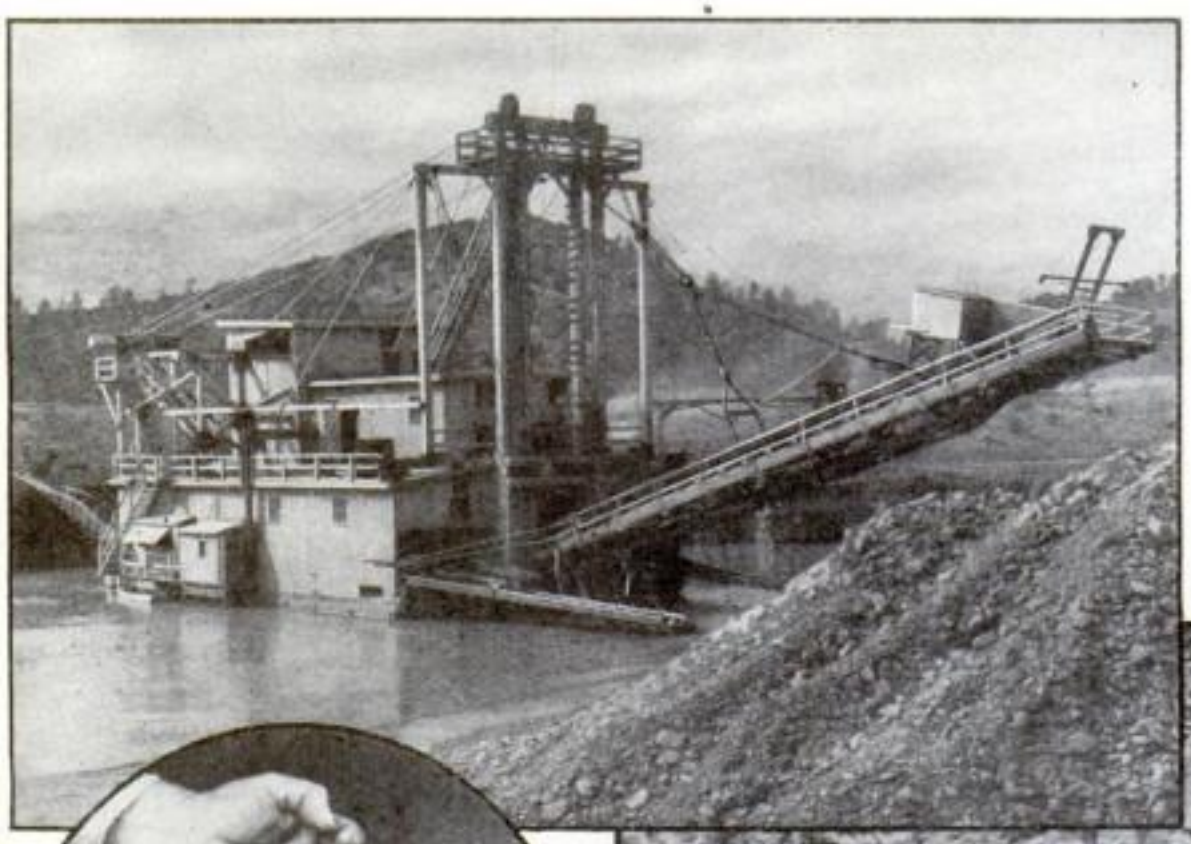
LIKE a mosquito ready to use its sting, Britain's newest war plane prepares to launch a death-dealing weapon in the striking picture at the right, snapped from below by an alert cameraman. The new machine is the first adopted by the Royal Air Corps in which are combined the functions of dropping bombs and torpedoes. In this view, an eighteen-inch Whitehead torpedo is seen ready for launching.

When the blast from propeller caught the open 'chute it dragged this pilot from his training machine

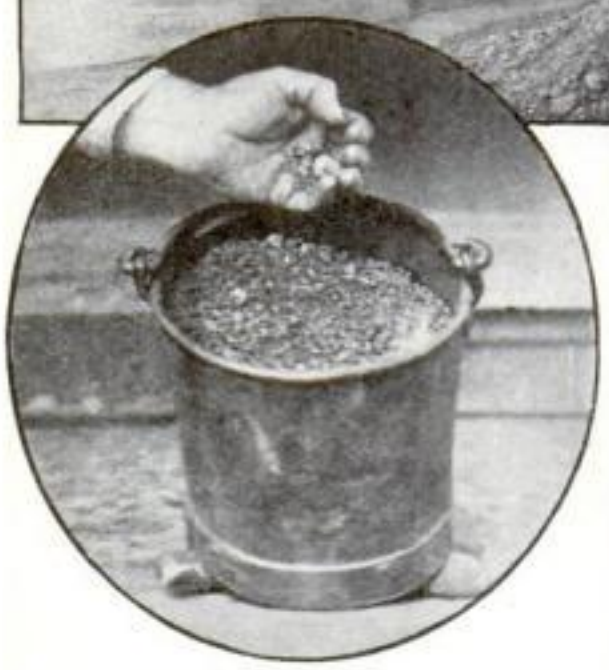
PILOT DRAGGED FROM MACHINE BY 'CHUTE

A WESTERN pilot recently became the first to make a parachute leap from an aviation training machine—but the stunt was not done intentionally. Wearing regulation flying equipment, Louis Babbs stepped into the cockpit to be whirled around and pitched up and down in the usual realistic tests for balance provided by the device. In some manner, while the training routine was in progress, the folds of his parachute became loosened, and the blast from the propeller did the rest. The camera shutter caught him just as he sailed from the machine in the tow of the inadvertently-opened parachute.

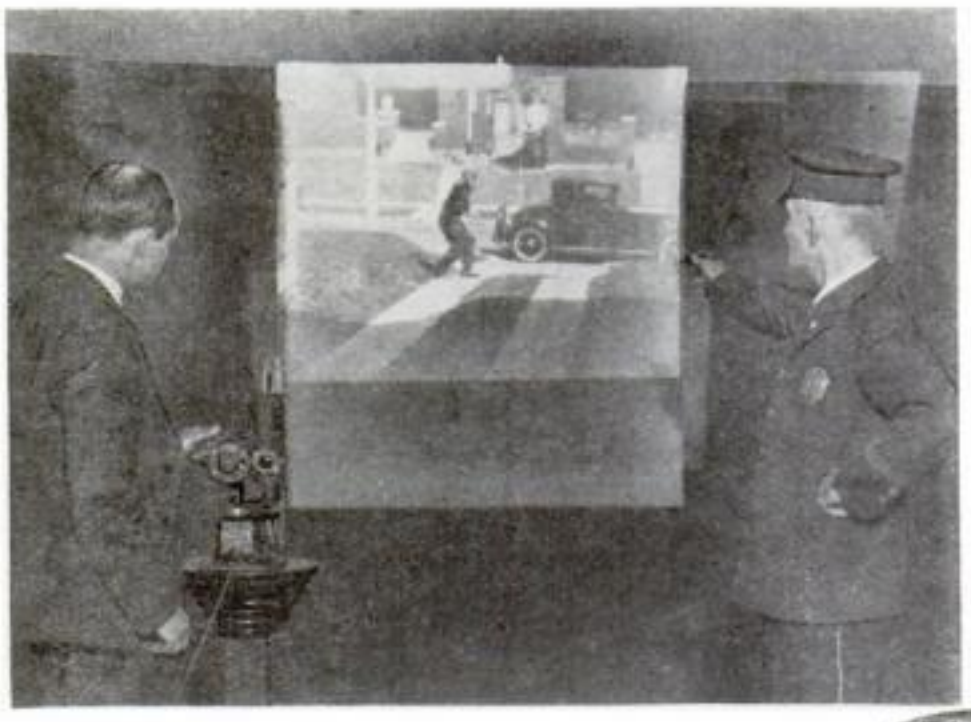
PLACER DREDGES DIG GOLD FROM WORKED-OUT BEDS



SCENES of the gold rush of the Forty-niners are being revived near Camanche, Calif., where historic old river beds are once again yielding pay dirt. The new gold rush occurred when modern machinery for extracting the glittering metal made it profitable to rework the beds. Monster placer dredges now move ponderously along the Mokelumne River valley, digging their own route, while many fertile farms have been abandoned to make way for them. The dredges' voracious jaws gulp up $700 worth of gold daily. They present a striking contrast to the hand apparatus that the prospectors of seventy-five years ago used to pan gold from river gravel. Note ridges of waste material in aerial photograph below.



At top, a dredge used to get gold from worked-out California beds. In circle, $10,000 worth of gold taken in two weeks with dredge. At right, an air view of the Mokelumne River, arrow showing a dredge



MOVIE TARGET HELPS POLICE SHOOT

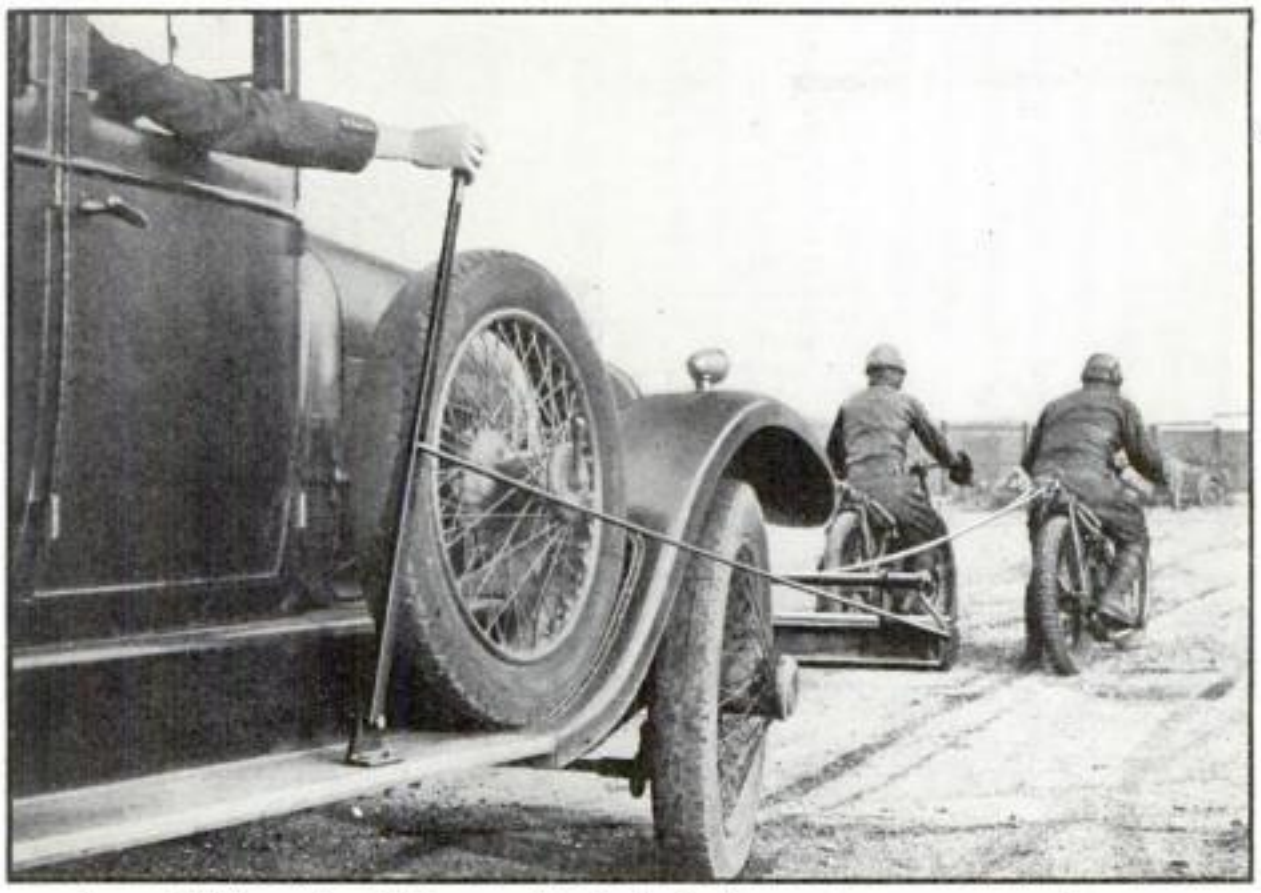
POLICE officers of St. Louis, Mo., now get realistic target practice by shooting at moving figures on a motion picture screen. A projector runs off a reel depicting gunmen and burglars in action, while the marksmen try their aim. The impact of a bullet automatically stops the projector, and a hole in the replaceable screen shows whether the bullet hit its mark. Members of the police department dressed as thugs enacted the scenaric especially for the purpose.

NEW SURF BOARD RUN BY MOTOR

STRANGEST of aquatic vehicles is a motorized surf board, invented by a Sydney, Australia, mechanic and built during his spare hours. He proposes its use for life-saving, since the speedy device would quickly reach a swimmer not too far from shore. The motor is incased in a protective housing and is capable of driving the craft at considerable speed. The board is so buoyant it will support the weight of two or three persons in case of an emergency. It can be operated in shallow water and would not be easily tipped by high waves, as would an ordinary rowboat.

An Australian built this surf board, which is powered with a motor

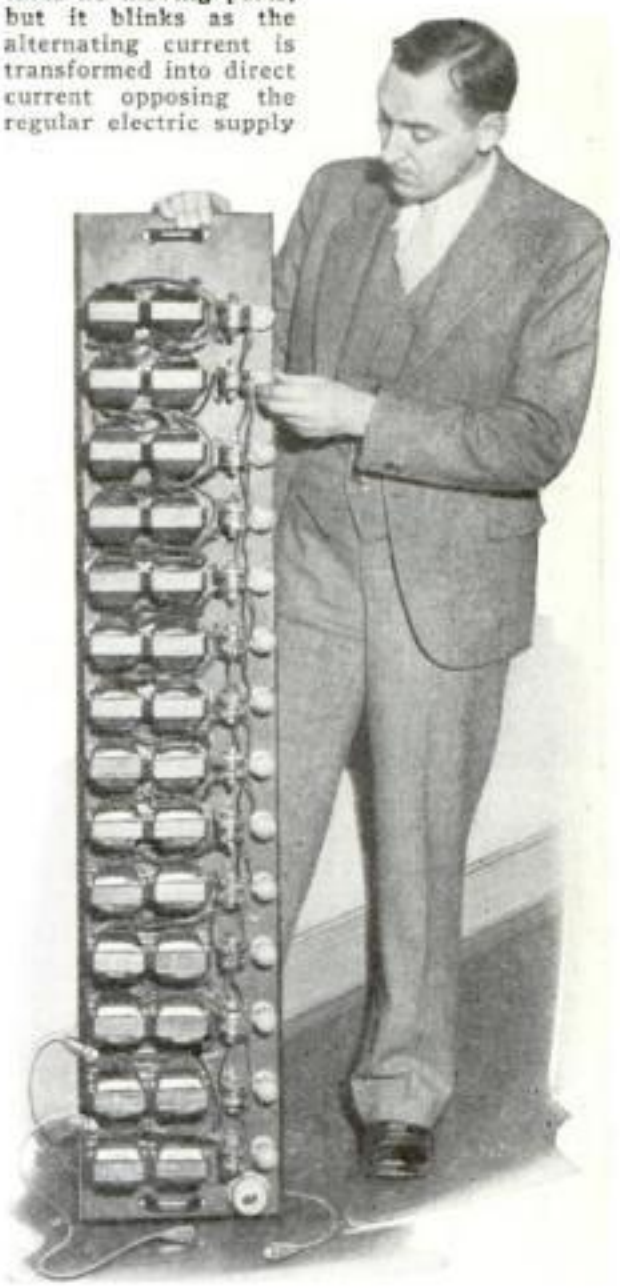
USE AUTO TO START MOTORBIKE RACERS



Automobile is used to hold motor bicycles in check to secure an even start in a race. Pulling the lever seen on the running board releases the two motorcycles at same time

So THAT motorcycle racers will get off to an even start, a new releasing apparatus is being tried out in England. The cycles are attached by ropes to a bar on the front of a motor car, and start down the track in leash at a signal from the starter. When they have attained sufficient speed, the driver of the automobile pulls a release lever. The ropes drop off and the motorcyclists are on their way. The photo above shows the motorcycles just before they were set loose.

This electric sign contains no moving parts, but it blinks as the alternating current is transformed into direct current opposing the regular electric supply



BUG POISON SPRAY HOOKS TO HOSE

ATTACHED to the garden hose, a new device makes an easy task of spraying the home garden with insecticide. Its tank and nozzle are attached to the hose, and the water turned on full force. With the hose turned so tank is down only water is sprayed. When it is desired to treat a plant, the tank is inverted as shown in the photograph and a spray of insecticide is shot out with the water.

Tank attached to hose sprays insecticide over plants

BLINKING ELECTRIC SIGN HAS NO MOVING PARTS

BECAUSE it contains no moving parts, a radically new type of flasher for animated electric signs is declared to reduce current consumption, as well as costly wear and maintenance. Through a circuit of rectifiers and transformers, part of the alternating current supply is transformed into direct current and intermittently opposes the regular electric supply so that each light blinks. By a suitable hook-up, a bank of lights may be made to flash automatically in sequence, and a wave of light travels along the whole line.

NEW LIGHT BULB REVEALS HEAT OF FURNACE

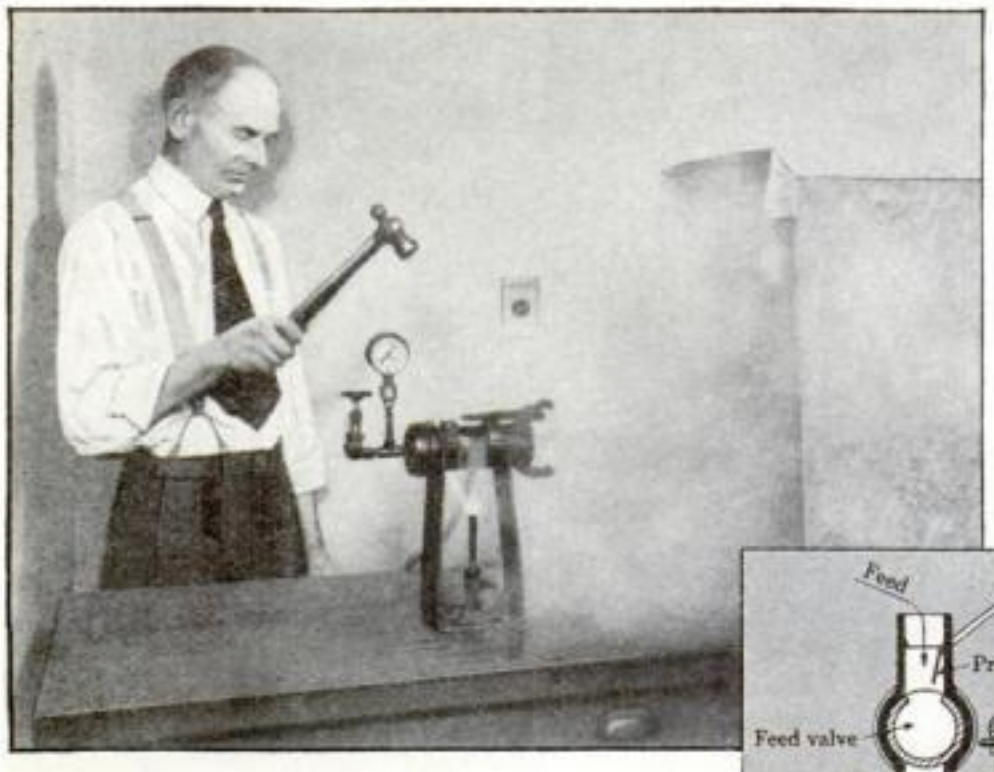
Sighting through this bulb gives approximate temperature of fire

A NOVEL type of lamp bulb has been devised by General Electric engineers to reveal the temperature within a furnace by sighting through the door. The pear-shaped bulb is coated black except for two transparent patches. The user looks through these at the fire, comparing its brightness with that of the bulb's filament. When the glow of the filament is matched with that of the fire, the temperature is read from an electric dial.

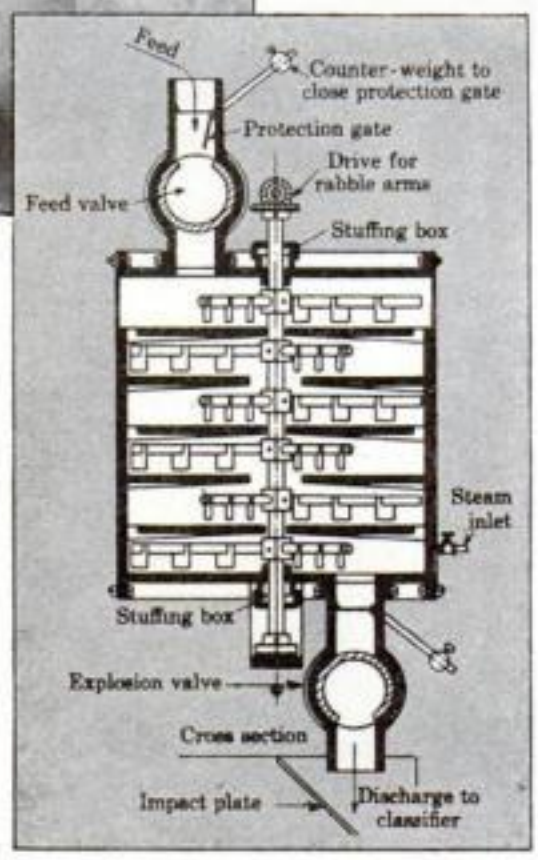
LINDBERGH INVENTION IS AID TO SCIENTISTS

VERSATILE enough to delve into medical as well as aeronautical science, Col. Charles A. Lindbergh, famous flyer, recently attained new distinction as inventor of an improved type of centrifuge for preparing blood corpuscles in research tests. His brief announcement of the device to the scientific world was the first public revelation that for several months he had been quietly assisting Dr. Alexis Carrel, noted experimenter of the Rockefeller Institute for Medical Research, in tests on tissue culture and the transplantation of organs. Colonel Lindbergh's new invention separates and washes blood corpuscles by whirling a vessel containing the fluid. In his centrifuge, Lindbergh has demonstrated that the washed blood corpuscles are uninjured and are therefore available for scientific study.

QUICK DROP IN PRESSURE SHATTERS ORE



At left, John Gross, metallurgist of the U. S. Bureau of Mines, releasing the valve that instantly cuts pressure and shatters ore by the explosion of steam. Below, how new process for treating ore may be applied commercially



SUDDENLY-released steam hissed as John Gross, metallurgist of the U. S. Bureau of Mines, struck with a hammer the trip of a strange-looking valve. Finely-shattered ore rattled like a discharge of buckshot against the sides of a sheet-iron hood placed in front of the valve. Gross had just demonstrated the explosive process of treating ore developed by himself and R. S. Dean, of the Bureau of Mines. Water-soaked ore was placed in the valve and heat was applied. When pressure in the valve rose to 150 pounds the trip was struck. The sudden fall in pressure caused steam within the ore to explode, shattering the ore into fine particles. This process was designed for the possible replacement of costly mechanical processes of crushing ores.

MOWING MACHINE CUTS HEDGE TO ANY SHAPE

WHEN Israel Evans of San Bernardino, Calif., became weary of cutting the hedge about his home, he invented a mowing machine to do the work. Operated by a gasoline motor, it will cut one hundred feet of hedge in thirty minutes. Its cutter may be raised or lowered to heights from one to four feet. Since it may be adjusted to cut vertically or at any angle, it is possible to shape the hedge as desired—squared or rounded—as satisfactorily as it can be done by hand and much more quickly. The sturdy construction of the mower can be seen in the photograph above showing the machine clipping the top of a square hedge level.

PUT ROCHELLE SALTS IN LOUDSPEAKER

ROCHELLE salt crystals have just been put to work at an entirely new job. A long series of experiments have led to the discovery that they can be used with excellent results in a radio loudspeaker. As the crystals change shape with the passage of an electric current the tone is reproduced with great fidelity. In the picture above two salt diaphragms and an unground bar of salt are shown.

ELECTRIC RAILWAY COST ONLY $40

AN ELECTRICAL railway has been built by students of John Muir Technical High School, Pasadena, Calif., for $40, under the supervision of George Henck, director of industrial arts for the Pasadena public schools. The items for the road, which can be duplicated by any mechanically inclined boy, were: quarter-horsepower electric motor, $7; wheels, axles, and trucks, $8; track, $9; ties, $3; body, $4; wires and movable boom, $9. Current is secured from the house system through wires that run to the top of an eighteen-foot mast. From there the wires are led along the swinging boom and drop down to the car's trolley. The thirty-inch cab is large enough for a fourteen-year-old boy to ride in.

Electric railway system built by schoolboys at a cost of $40

WATER CARTRIDGE SHATTERS CONCRETE

BY TWISTING a small handle, one man can now shatter ponderous blocks of concrete. The feat is made possible by a new tool that works upon the principle of the hydraulic jack. The screw handle forces home a piston, driving water into a "hydraulic cartridge" placed in a drill hole. Five small rams on the side of the cartridge are thrust out by the water pressure, applying a force of as much as 240 tons, and crumbling reinforced concrete like clay. The photograph shows a huge block of concrete split with the cartridge.

WORKS NEW GREASE GUN LIKE RIVETING HAMMER

BUILT like a pneumatic riveting hammer, a new grease gun shoots lubricant successfully into joints that are tightly clogged with hardened grease. Compressed air is used to drive its piston, which delivers a series of hammer blows upon a stream of grease and forces it into the joint under a pressure of as much as 10,000 pounds, if necessary. Because of the tool's design the pressure is confined to the working parts and is not transmitted to the hose or the compressed-air tank, where it might cause trouble. The force of each piston blow is retained and the next added to it as pressure rises. In the case of average bearings that do not require such strenuous treatment, only the pressure necessary is built up.

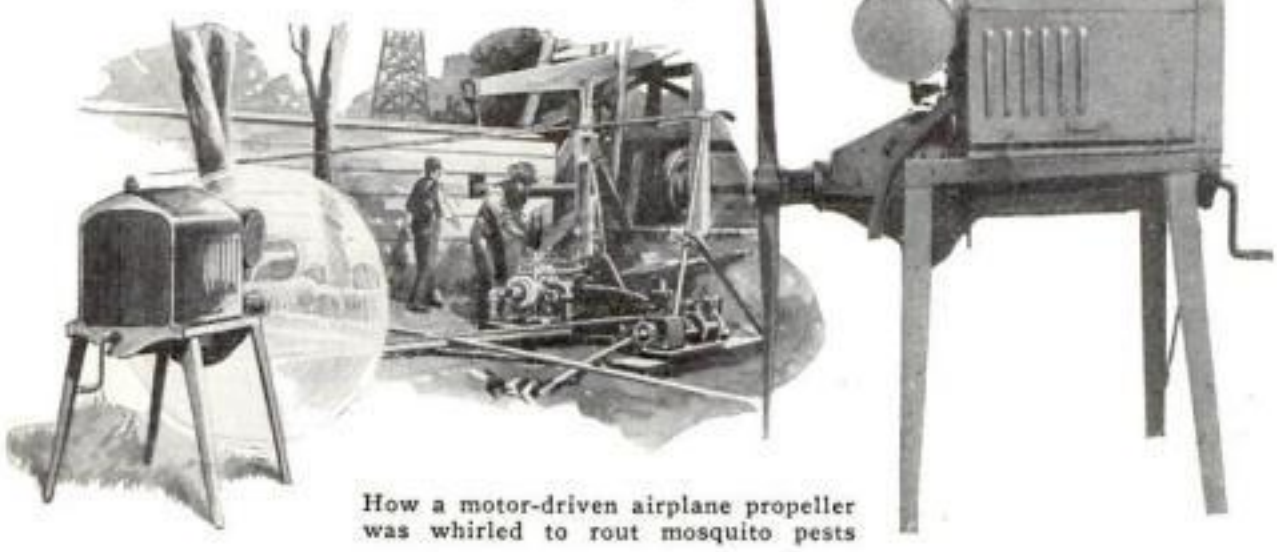
Enlargements from movie film are mounted as above. Flipped leaves give illusion of an animated picture

CASE THAT FITS POCKET HOLDS HOME MOVIE

AN AMATEUR photographer may now carry in his pocket and exhibit with little inconvenience a brief selection from one of his own home movies. This is made possible by an ingenious application of an old principle in a new pocket movie outfit. Enlargements from the user's own film are mounted on successive pages of a folder especially designed for the purpose. When the pages are flipped over with the thumb like the pages of a book, the pictures become animated like a real movie.

PLANE'S PROPELLER ROUTS MOSQUITOES

WHEN mosquitoes plagued a crew drilling oil wells in a Louisiana swamp, the men mounted an automobile engine on an iron frame and attached an airplane propeller. The "skeeter chaser" worked, and its strong air current now keeps the insects away, while the men work in peace while also cooled by the blast.



How a motor-driven airplane propeller was whirled to rout mosquito pests

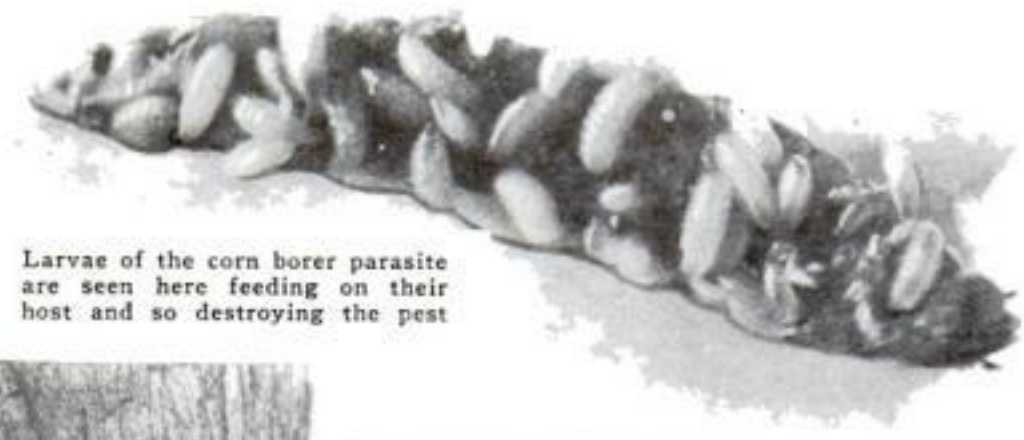
TIME BOMBS NOW USED TO SHOOT OIL WELLS

Bomb has time clock which fires it off at bottom of deep oil well

MODERN methods of "shooting" oil wells demand ample time for the shooters to finish their tamping and retire to a safe place. To meet this need, ingenious time bombs are now in use. Loaded with dynamite and accurately set to explode after a predetermined interval of from one to eleven hours, they are carefully lowered into the drill shaft. At the exact moment indicated by the clock-like mechanism the electric circuit of a small dry-cell battery is closed and this in turn ignites a detonator cap and sets off the dynamite. The bombs are either single or duplex, the former having one watch and one circuit and the latter, two watches and two circuits.

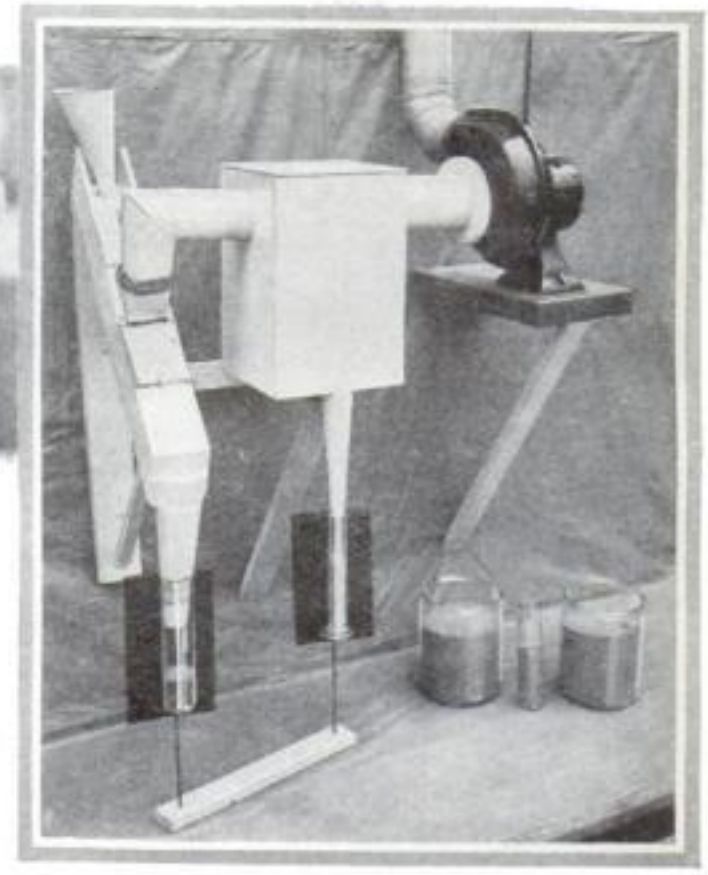
BUG *eats* BUG TO SAVE American Farms

With this vacuum-cleaner-like device, eggs of the grain moth are collected by Department of Agriculture scientists to feed fruit moth parasites



Larvae of the corn borer parasite are seen here feeding on their host and so destroying the pest

A burlap band on the tree traps caterpillars of the destructive gypsy moth, here since 1889



This apparatus separates larvae of the gypsy moth parasite from the material in which it is packed for shipment from distant countries

By CLAYTON R. SLAWTER

AN INTERCONTINENTAL airline plane settled to earth the other day at the Miami, Fla., airport after a long flight from South America. Part of its cargo consisted of infinitesimally small winged creatures, thousands of wasps that were being rushed here to aid in the war against the sugar-cane borer that was ravaging cane crops in Louisiana.

Days earlier a great transcontinental plane landed, at the Camden, N. J., airport, a cargo of wasps of another species consigned to the United States Department of Agriculture's field laboratory at Moorestown, N. J. These wasps had been shipped from Sydney, Australia, to San Francisco by steamer and then flown across country to aid in the war against destructive insects.

These imported wasps, I learned at the Department of Agriculture, represent only a small portion of the countless number of foreign insects brought into this country each year to help American farmers in their war against insects that destroy their crops. There are many such crop pests that cannot be controlled efficiently by man-devised methods, among them being the sugar-cane and corn borers, the pine-tip and gypsy moths, and the Japanese beetle. There are, however, other insects deadly to these pests. So when artificial methods fail, entomologists of the Department of Agriculture travel far afield in a search of insect enemies of the bugs that ruin American crops and plants.

Literally the entire agricultural world is combed in this search. From the Malay Archipelago to the south of Europe, from kaoliang fields of Manchuria to the grain lands of Eurasia, agents of the United States Government travel on their quests. H. H. Jaynes, one of the Department's entomologists, spent three years in South America searching for parasites of the sugar-cane borer that had invaded Louisiana. His search was rewarded by the discovery of the fly and wasps that were rushed to this country by plane. The flies successfully withstood the boat journey from Peru, where they were found, to New Orleans, but the more delicate wasps were shipped by air. Even this shortened trip was fatal to many of them, so Jaynes devised special containers in which were tiny drinking fountains and minute cups of granulated sugar to supply the food and drink that kept most of the insects alive on their journey.

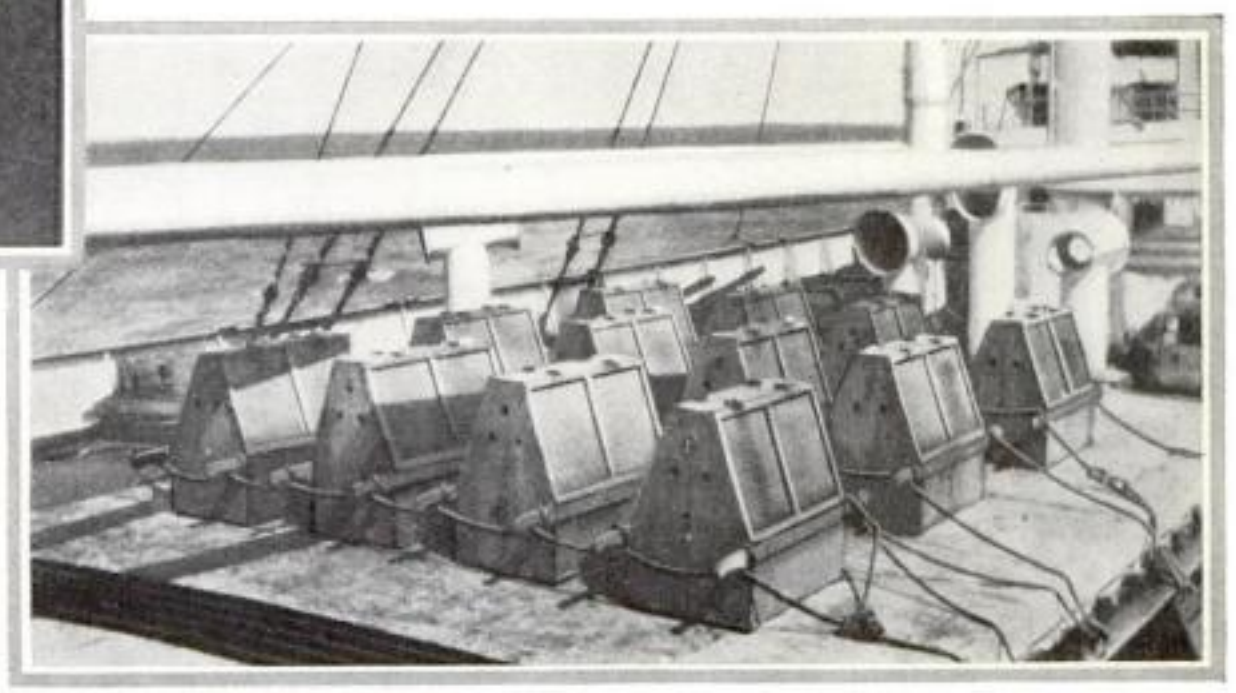
During the past year almost half a million insects were shipped into this country from the Department of Agriculture's entomological laboratory at Hyères, France. These bugs were sent here to help American farmers in their war against the European corn borer. This destroyer of corn crops invaded the United States prior to the war period, supposedly by way of imports of broom corn from Italy. By 1919, it had done so much damage that the Department of Agriculture took a hand in attempting its suppression.

Mechanical methods of control having proved ineffective in fighting the borer, parties of entomologists were sent to Europe and Asia on a hunt for insect parasites of it. Such expeditions established field laboratories at many points for breeding specimens of insect parasites from locally parasitized borers.

From the south of Europe came the most efficient enemies of the corn borer. Since 1919, when American entomologists established their field laboratory at Hyères, each year has seen vast numbers

CROP DESTROYING PESTS Are Killed by Parasites Captured in Remote Lands and Released in This Country

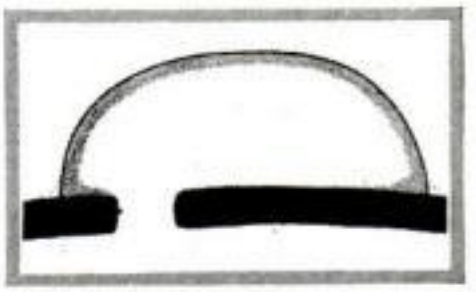
This Japanese beetle grub is now just a hollow shell as the parasite larvae, feeding from the inside, has consumed the grub and is seen fully grown standing on remains of its host



These twelve cages of infested plants were taken from Cuba to Singapore where parasites were collected and transferred to the plants in the cages and then brought back to Cuba

SPECIAL CAGES FOR PEST ENEMIES

Insects are moved in this case which was designed by Department of Agriculture experts. It has screens covered with cellophane to admit light. Note handles for carrying cage



Cross section of egg of Japanese beetle parasite. Without breaking the shell the larva enters its host

of various enemies of the corn borer shipped to grand headquarters at Arlington, Mass.

The corn borer, a mothlike creature, deposits its eggs in cornstalks. Caterpillars, hatching from these eggs, tunnel into the stalks and spin cocoons, from which eventually emerge adult borers to complete the vicious circle. One of the most effective of its many enemies is a flylike creature that deposits living maggots in or near tunnels made in cornstalks by the borers. These maggots find the young borers, burrow into them, and begin devouring them from inside out.

Searching entire continents for such minute insects seems a stupendous task. The first step is to find areas where crops similar to those being attacked in this country—broom corn, for example—grow. This foreign corn is then examined for European corn borers that are being parasitized by other insects. When found, they are taken into field laboratories and reared under ideal conditions, while the prying eyes of microscopes peer into the most intimate details of their private lives. If a parasite is found that seems to show special fitness for the task of fighting the borer, it is shipped in quantities to Arlington, Mass., where it is again bred under laboratory conditions before being released in infested fields.

Not always does the Department of Agriculture wait until insect pests of crops have invaded this country before sending entomologists abroad to hunt for killing parasites. Should a serious crop pest appear in a near-by country, where there is a possibility that it may be brought into the United States, it is attacked by American entomologists while it is yet on foreign soil. The invasion of Cuba by the citrus-fruit black fly is an instance of such a campaign carried out by the Department of Agriculture for the protection of American citrus-fruit crops. I talked to C. P. Clausen, the entomologist who had handled this work.

"The black fly," he said, "had not appeared in this country, but it was doing terrible damage in Cuban citrus-fruit groves. It was felt that it would be but a matter of time before the pest arrived in Florida, so steps were taken to prevent the threatened invasion. The American Government allied itself with that of Cuba in declaring war on the black fly. Cuba's part in the conflict was to be purely defensive, the enemy being already within her borders. Uncle Sam's share in the campaign was to attack the black fly on Cuban soil to protect Florida citrus-fruit growers. Both of the governments were to share equally in the expenses."

When fully grown, Clausen explained, this black fly is a small black gnatlike insect about twice as large as the head of a pin. Early in life, it attaches itself to the underside of a citrus plant leaf, remaining in that position until it reaches the adult stage. As many as 1,000 black flies have been counted on one leaf. Raising as it does a new generation every two months, this destructive insect soon outstrips man-devised methods of attempting to check its spread. Once it secures a firm foothold in a grove, that grove is doomed to almost certain destruction.

"Nature, having created this pest," went on Clausen, "has herself devised the most effective weapon that can be used against it. This is a small insect of the wasp family found throughout tropical Asia. The citrus-fruit black fly is also found in those parts, but it never assumes the menacing proportions there that it does on our own side of the globe. These little wasps, for which I was searching, keep it in check. So it was my task to induce some of these wasps to leave their Asiatic homes and come to Cuba with me."

With him on his long journey, Clausen took specimens of black-fly infested Cuban citrus plants. These were boxed in special cages, so any flies maturing during the trip could not escape. Citrus-fruit groves of pomelo, a sort of grapefruit that harbored the black fly, were found at Kuala Lumpur, Federated Malay States; Muar, Johore; and Medan, Dutch East Indies. From his Cuban plants, Clausen took black flies and liberated them on pomelo plants specially caged for the purpose. Such artificially infested native plants were allowed to stand outdoors for a while until they attracted the attention of the wasplike insects that would attack the black fly.

It is the female of the species of this parasite that is deadly to the black fly, Clausen told *(Continued on page 109)*

Erupting Volcanoes Change Weather

Here is one of the 400-mile string of South American volcanoes that recently roared into action. Experts who have studied such eruptions believe the quantity of volcanic ash thrown out and carried far by the winds will have a marked effect upon the weather of countries remote from the center of activity and may bring a cool summer into the regions that lie to the north

Above, another Chilean volcano belching smoke and ash into the air. At left, children playing in the heaps of volcanic ash, building it into mounds after it was shoveled from the streets

WILL South America's recent volcanic eruption change our weather? Experts anticipate that possibility since a 400-mile string of volcanoes along the Andes roared into action like a salvo of big guns a few weeks ago, shaking Chile and Argentina for two days and nights with their cannonading.

The greatest eruption of modern times, in area involved and quantity of lava emitted, left thousands of square miles of country looking as though it had passed through a snowstorm. White volcanic ash, lava blown to a fine froth, was borne clear across the continent on the wind. This ash may affect the weather, since its particles serve as nuclei around which cloud droplets form.

If the Andean ash has spurted as far as ten miles high, Prof. W. J. Humphreys of the U. S. Weather Bureau predicts, some of it may drift indefinitely, crossing the equator to the Northern Hemisphere, blanketing us with clouds. With somewhat less altitude, the floating ash may be confined to South America.

In the past, volcanoes have been weather-makers. Katmai, in Alaska, blew its top off in 1912, and vast territories of the United States hardly saw the sun at all that summer. The East Indian volcano Krakatao ejected more than four cubic miles of ash in 1883; it drifted entirely around the world, and for several years unusual red sunsets were observed.

At Curico, Chile, an army of men were put to work, following the volcanic eruption, shoveling the finely powdered ash out of the streets where it lay in drifts as snow heaps the highways

Half-Blind Tricked into Seeing

University of California, with New Method, Restores Normal Sight When One Eye Fails

Failing sight is cured by a process developed at the University of California which stimulates activity in the weak eye. Above, a tiny beam of light is thrown on a screen where, as it dances around, the patient tries to follow it with his sick eye, thus inducing an effort to see normally

With his good eye covered, the patient, right, sits before an illuminated revolving screen of red and white. This exercises the weak eye by forcing it to follow the motion from the center to outside of curved lines

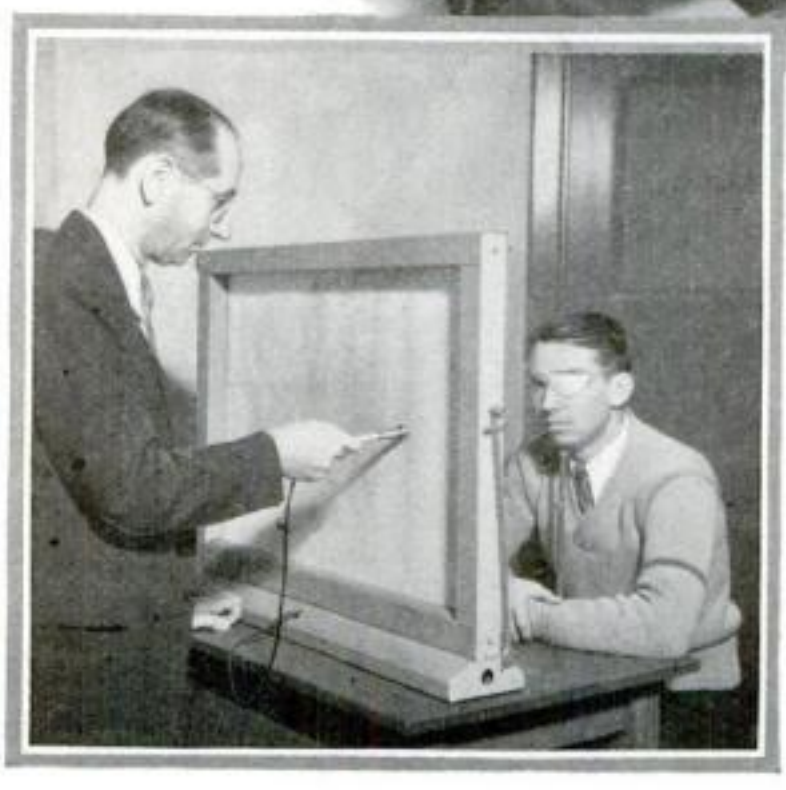
FAILING EYE MUST SUPPLY LOST LINES

Through this stereoscope-like instrument, the patient looks at two sketches, one with each eye. One sketch is complete, but the one seen by the weaker eye is incomplete, as shown below. The patient is directed to draw in the missing lines to complete the sketch, stimulating the weak eye to regain lost powers

HUNDREDS of residents of Los Angeles, blind in one eye, have recently had perfect vision restored. The success is a tribute to a remarkable new method of treating partial blindness developed at the University of California using two new instruments—the "manuductor" and "telebinocular."

The purpose of these instruments, and others developed by the California technicians, is to trick a failing eye into seeing again before its dereliction throws a damaging strain upon the other one. Before the "manuductor," which resembles the old-fashioned parlor stereoscope, are placed identical sketches. One is complete; the other has a few lines missing. When the patient fills in the missing lines, using his defective eye, it is teased into working.

Another instrument, the "telebinocular," counteracts the cause of squinting. This is the acquired laziness of one eye to follow the direction of the other's gaze. Twin pictures are viewed in a black box. The one before the poor eye is lighted steadily; the other, at quarter-second intervals. Each time an electric flasher operates this lamp, the poor eye is simultaneously pulled into line in an effort to coordinate the two images. Soon the laggard eye becomes more responsive and the flashing effect is gradually diminished until normal vision is restored.



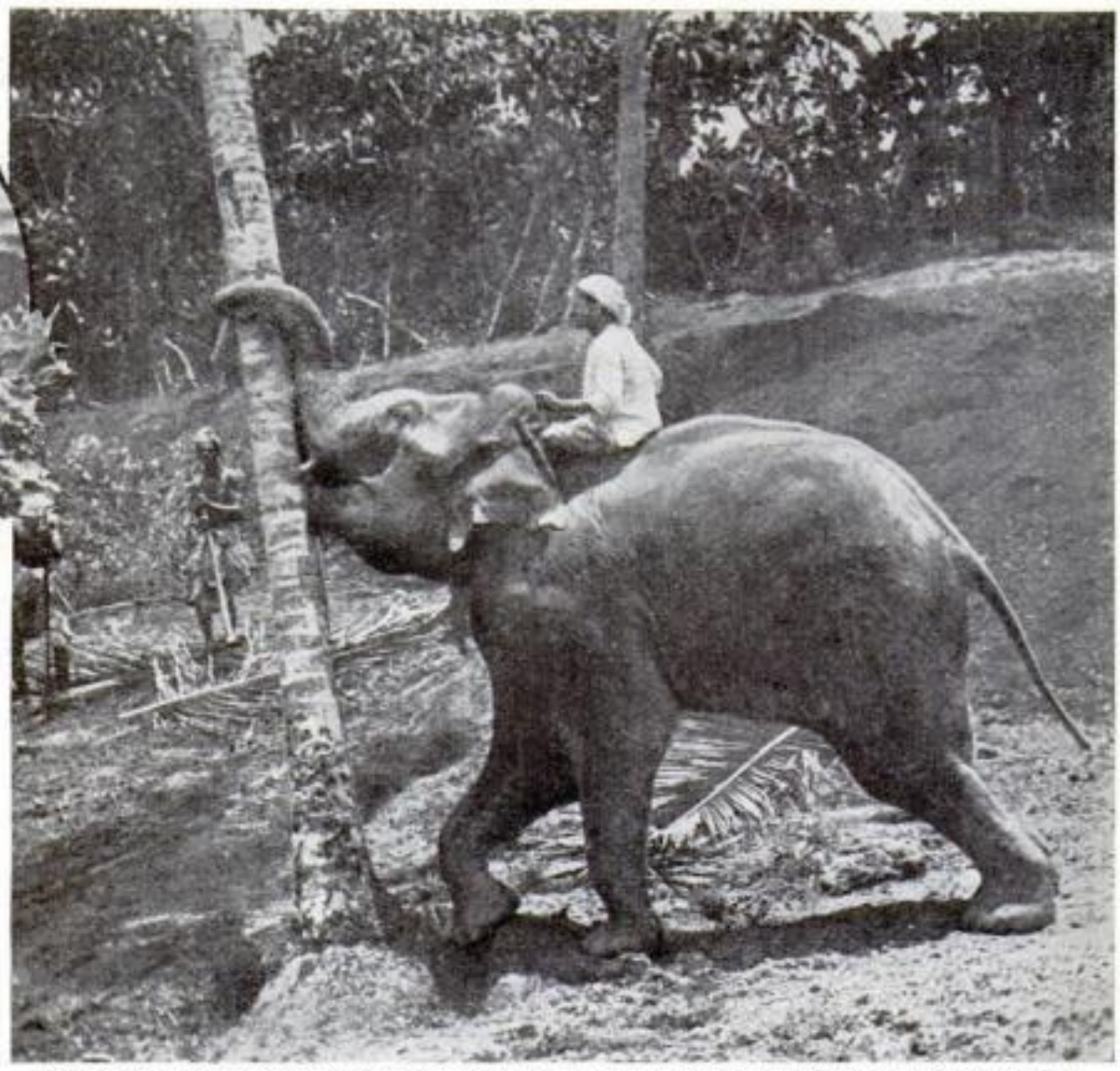
In the telebinocular, above, twin pictures are viewed. That seen by weak eye is lighted constantly, the other at intervals. This causes eye under treatment to follow direction of the good eye's gaze

Where is the patient's blind spot? This is found as he looks intently at one spot while the light point moves across the screen. The point at which the light disappears locates his blind spot

REMARKABLE PHOTOS SHOW ELEPHANT AS LUMBERJACK

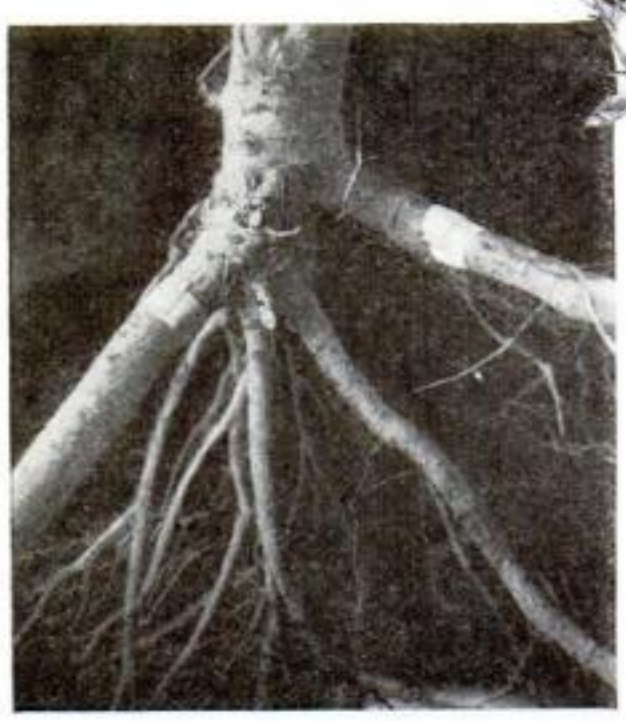
A chain placed around a fallen tree is grasped by elephant's trunk and tree dragged away

ELEPHANTS have long served as lumberjacks in India, where the brute power of a single beast replaces the efforts of a crew of men. The striking photographs reproduced here, just received from Ceylon, give an unusually clear idea of the spectacular operation. A young domesticated elephant, responsive to the commands of its keeper sitting astride, wraps its trunk about a tree thicker than a man's waist and easily uproots it. With the aid of a chain that serves as a handle, the animal then drags the tree away.



A domesticated elephant in Ceylon wraps its trunk around a growing tree and uproots it

FLOWERPOT ORCHARD BEARS FULL SIZE FRUIT



Real fruit trees can be grown in a flowerpot when dwarfed by stunting main roots, at points taped in photo at the extreme left. Apples on tiny tree above are of ordinary size and flavor

APPLES, pears, and peaches as fine as the market offers may now be grown on three-foot shrubs in flowerpots. The entertaining hobby of raising an "indoor orchard" is made possible, for anyone with the time and patience to try it, by the discovery in France of a way to stunt fruit trees of many kinds, without impairing the quality of their fruit.

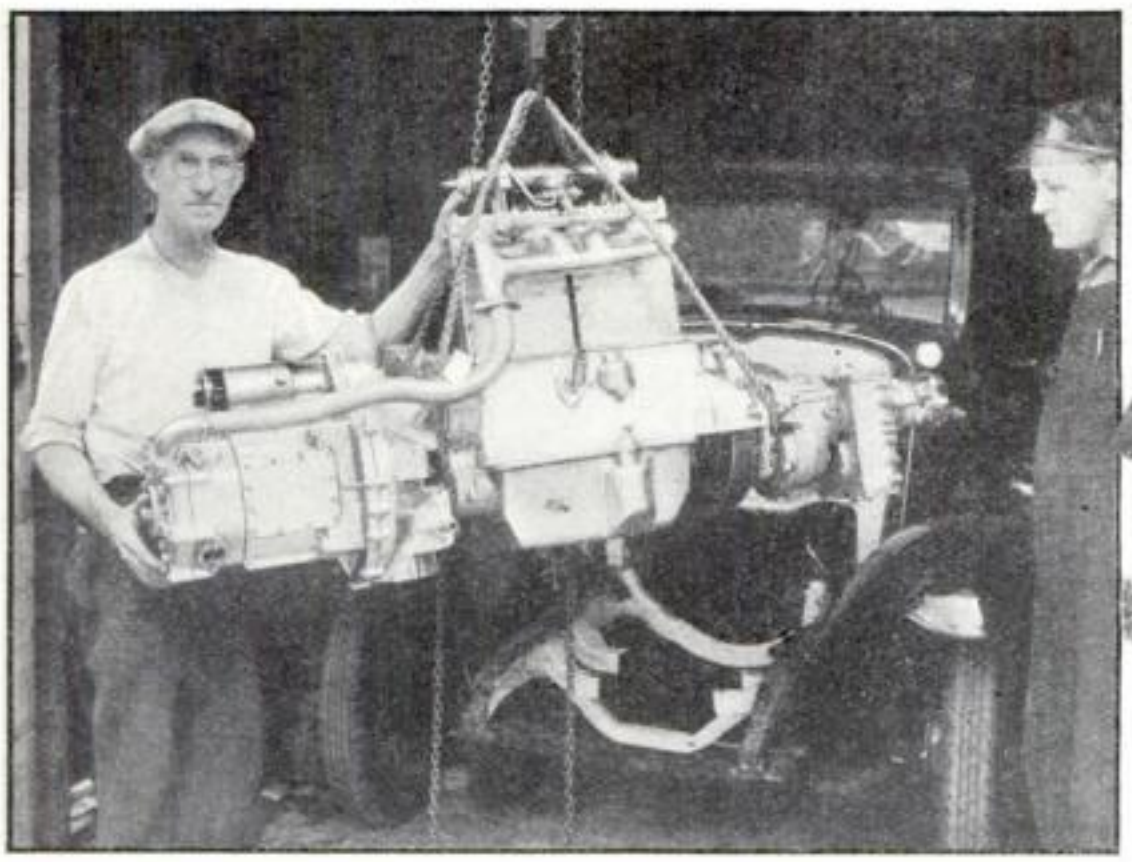
Careful pruning of the roots, together with a few cuttings of the branches to induce compact foliage and prevent loss of moisture, is the secret of producing a miniature fruit tree. The original tree may be bought from a nurseryman, provided it is not more than two years old, or it may be raised from seed. Purchasing grafted stock will save the need for home grafting. The first step in dwarfing is to cut or "strangle" the main root by tying wire firmly around the base. In about two months the root is stunted, preventing the plant from taking too much nourishment and thus dwarfing it. Meanwhile branches with excessive leaf growth are pruned. These operations are repeated in early spring or late fall for several years, until the tree is permanently dwarfed. About this time it begins to bear healthy fruit. Guests may be served fresh fruit from a dwarf tree on the dining room table.

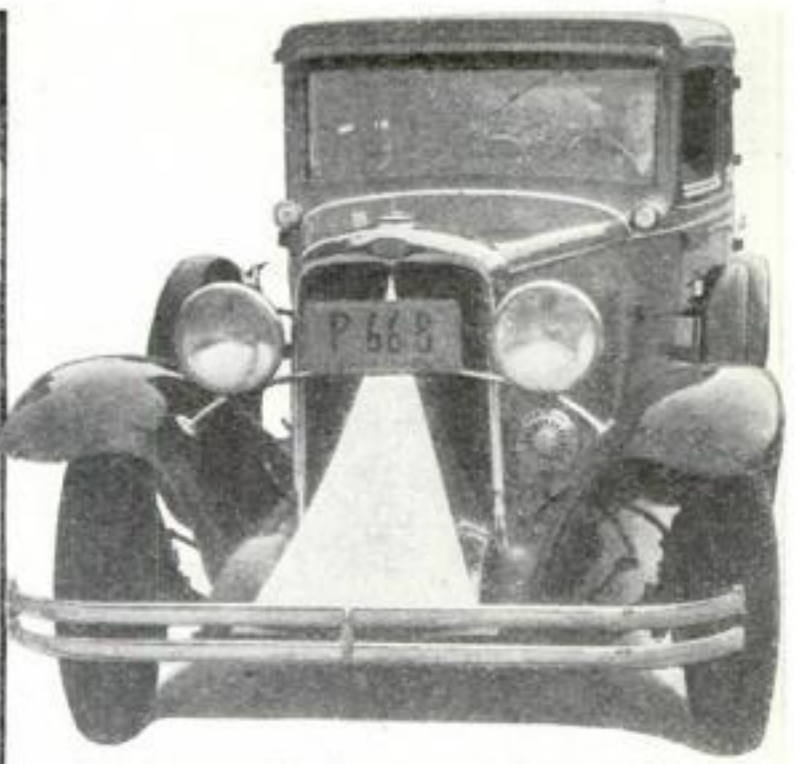
STREET SWEEPERS WEAR RED LIGHT ON ANKLE

STREET sweepers who work until late hours in Leipzig, Germany, no longer fear being run down by motorists as dusk approaches. They now wear "ankle lights." These miniature red reflectors are attached to the ankles by encircling straps. In the rays of an automobile's headlight, they flash back a warning to the oncoming driver that someone is working in the roadway ahead.

Street sweepers in Leipzig, Germany, wear warning red reflectors fastened to ankles

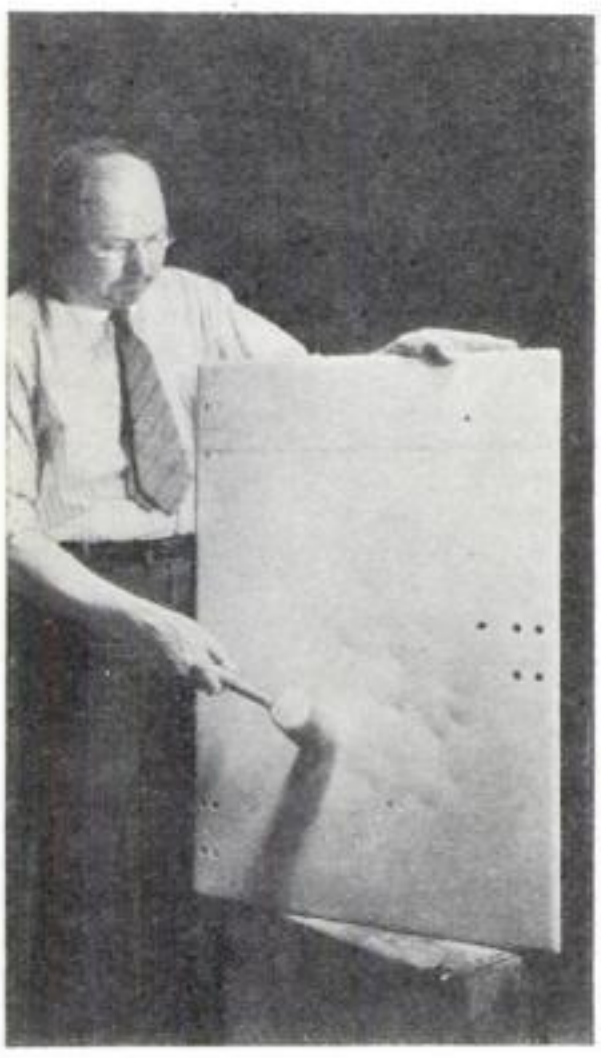
New Compressed Air Auto Powered with Vertical Engine





Above, new model of compressed air automobile showing the flaring housing that holds electric reheating apparatus. At left, vertical motor that replaces rotary

Roy J. Meyers, California inventor who a few months ago exhibited a car driven by compressed air instead of gasoline (P.S.M., Jan. '32, p. 60), has now perfected an improved model of his unusual vehicle using a vertical instead of a rotary engine. In front of the new car's radiator, a flaring housing gives the machine a distinctive appearance. It accommodates electric apparatus that reheats the air from the motor's exhaust, so that it expands and may be used once more.

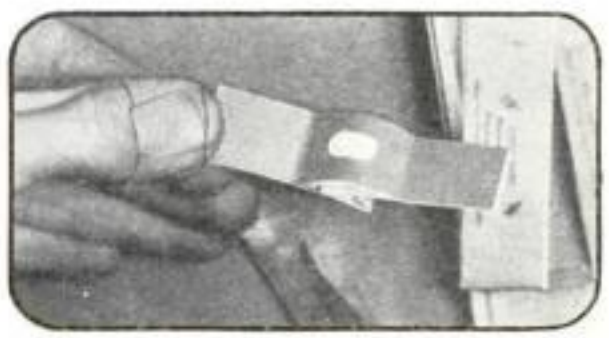


BLOW FAILS TO CRACK ELASTIC PORCELAIN

Free from chipping or peeling is a new "elastic porcelain" of smooth surface and lustrous snow-white appearance. Striking it with a hammer or mallet will not crack the material, but will produce a slight dent. Because of its flexible properties, the material's metal base may contract or expand with changes in temperature without damaging it. The new substance is being used in the lining and exterior of refrigerators, and may be adapted for other finishing uses.

BANDAGE IS WATERPROOF

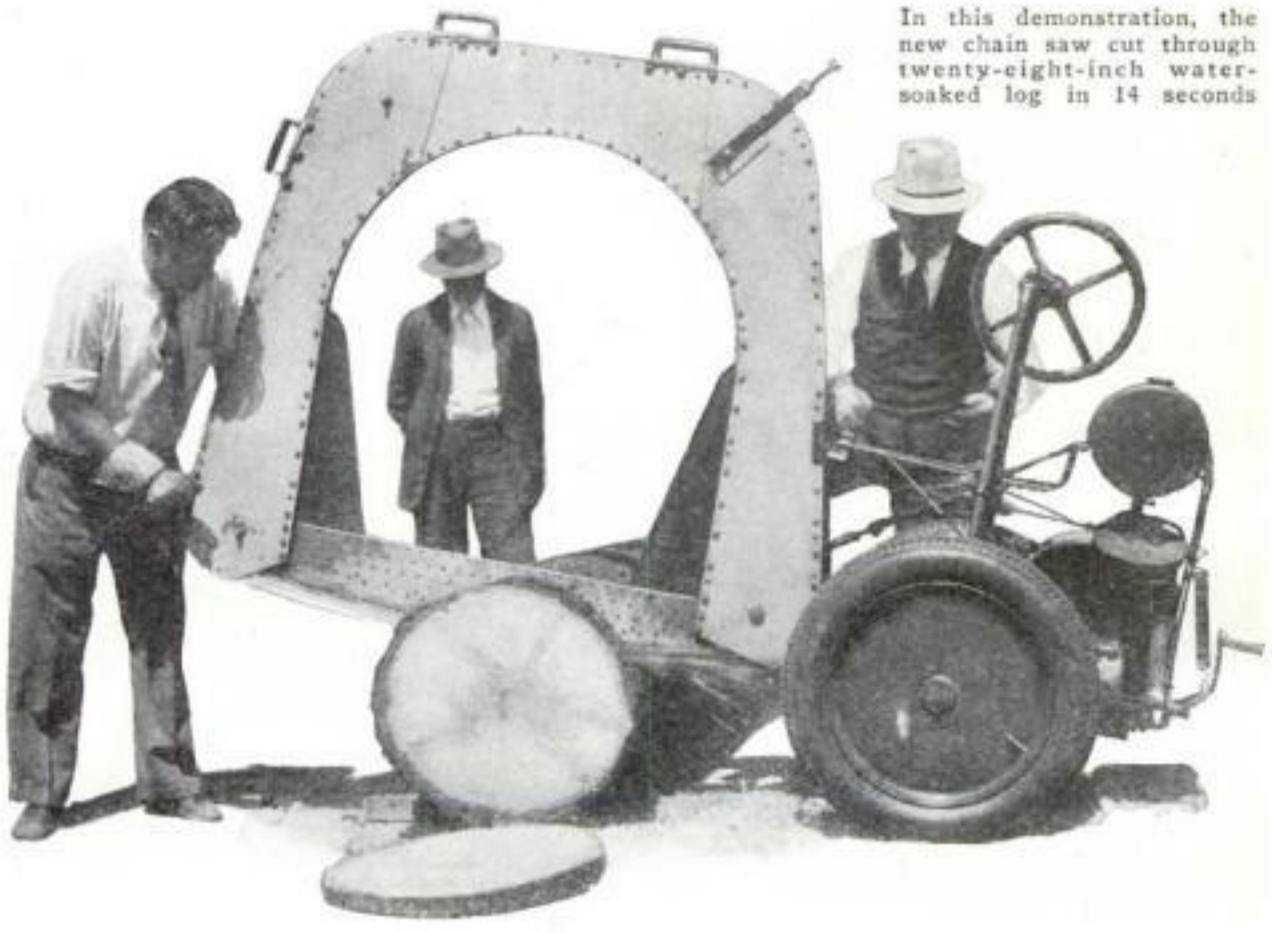
Small wounds may now be dressed with a new kind of bandage that does not become loose when wet. A pad of gauze is held in the center of a strip of adhesive tape that has a moisture-proof backing. Strips of crinoline cover the sticky surface and the gauze, and are removed before the bandage is applied. The bandages are sold in handy individual packages.



Adhesive tape bandage is waterproof

MOTOR-DRIVEN CHAIN SAW CUTS FAST

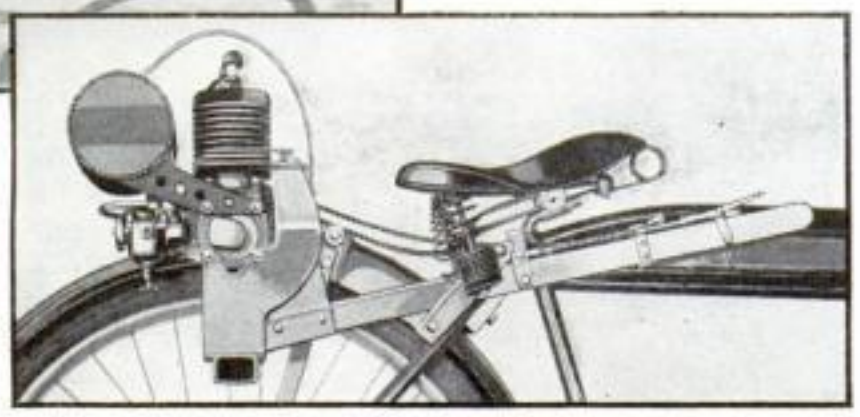
Short work is made of the thickest timber by a speedy new motor-driven chain saw. In a recent demonstration it cut through the twenty-eight-inch water-soaked log shown in the photograph in fourteen seconds. Either fallen logs or standing trees may be cut with the new tool. It rolls to the place of use on pneumatic tires, and handgrips are bolted to the frame to facilitate control.



In this demonstration, the new chain saw cut through twenty-eight-inch water-soaked log in 14 seconds

"OUTBOARD MOTOR" FOR BICYCLE NOW

AN "OUTBOARD motor" for bicycles, suggesting those used on water craft in its design and mounted on the rear, has recently been placed on the market. Power is transmitted by a friction drive to the tire of the rear wheel. A handlebar thumb button controls the speed of the one-cylinder motor, while a hand lever just ahead of the saddle raises the whole motor to disengage it from the wheel when desired. It locks in drive position so that it will not bounce. It is said to propel a bicycle at a maximum speed of thirty miles an hour.



A tiny one-cylinder motor in contact with the rear wheel of this bicycle drives the machine at thirty miles an hour. View at right shows how the "outboard" motor is mounted behind the rider's seat to run the bike by a friction drive

WOOL FROM JUTE FIBERS LOOKS LIKE REAL THING

ARTIFICIAL wool that defies detection as a substitute for Nature's produce may be made from ordinary jute fibers, now used for gunny sacks, through a new chemical process. Coloring matter in the jute is removed by treatment with a weak alkali. An acid bath and another dipping in alkali follow, the last treatment putting a wool-like kink into the fibers to make them retain heat. The process was devised by Prof. Ralph H. McKee of Columbia University, who recently announced the process for producing artificial diamonds that is described on another page of this issue. In the photograph above he is comparing raw and manufactured artificial wool (at left) with natural wool.

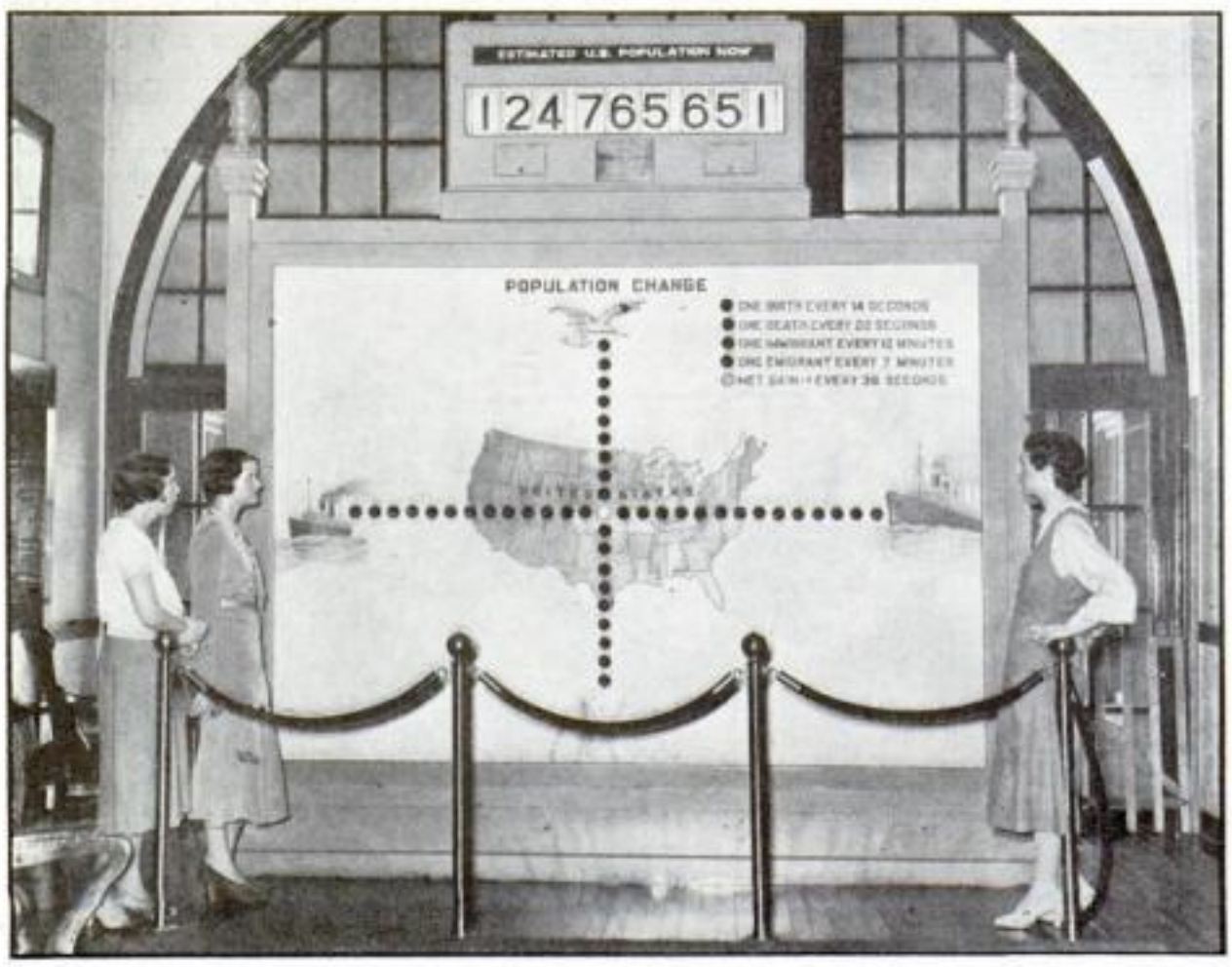
FLOATING VALVE MAKES WATER FAUCET TIGHT

DRIPPING faucets are banished, according to the maker of a new "floating valve" that replaces the ordinary washer. This diminutive device, a brass button with a face of tough, elastic material, pivots freely upon a metal pin when the faucet is closed. Since the face does not turn, it is not subjected to grinding and consequent wear, and therefore is said to make a water-tight seal. When the faucet is turned on, water pressure lifts the "floating valve" automatically.

This new type floating valve for a water faucet pivots upon a pin so its face is not worn by use

CLASP ON BILLFOLD HOLDS IT IN POCKET

FOR those who guard their money carefully, an "unlosable" billfold has been invented. When a sliding clasp is locked to the edge of the hip pocket, the wallet cannot slide out accidentally. The clasp's bulldog grip also discourages the fingers of pickpockets. The user, however, has no difficulty in operating the clasp with his thumb when he wishes to withdraw the billfold. The sliding clasp allows it to rest at the bottom of any depth pocket.

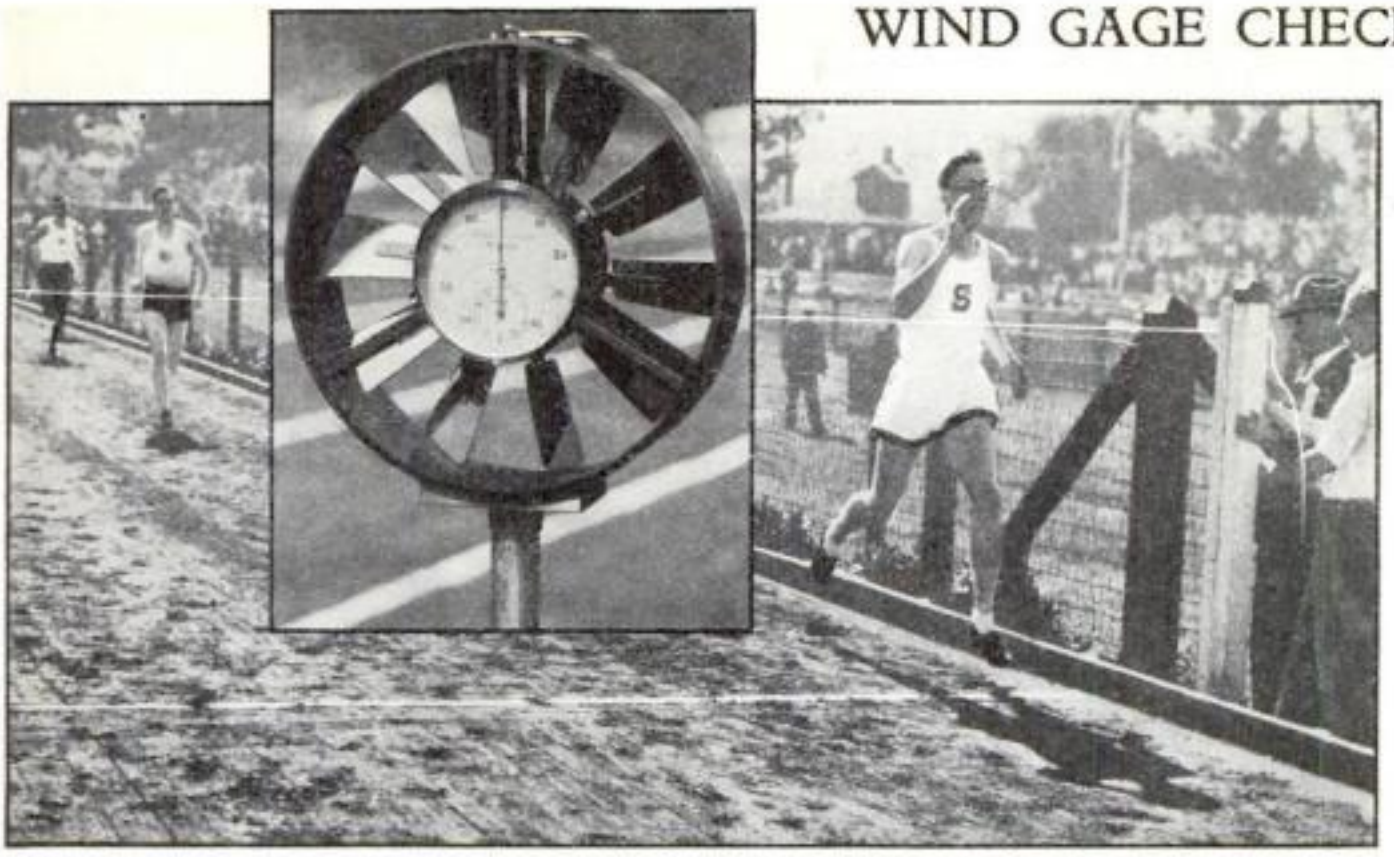


The large figures at the top record the constantly changing population of the United States

MACHINE KEEPS TAB ON AMERICAN POPULATION

ON A big panel in the Census Bureau at Washington, D.C., colored lamps and flashing figures keep tabs on the ever-changing population of the United States. When this picture was taken, the "population clock" recorded a total of 124,765,651 men, women, and children. The Census Bureau estimates that one birth occurs every fourteen seconds and one death each twenty-two seconds. An immigrant arrives every twelve minutes, while an emigrant departs every seven minutes. Thus the Bureau figures there is one new head every thirty-six seconds.

WIND GAGE CHECKS RACING FEAT



Officials of Stanford University have set up this wind gage, insert, to check the record-breaking performances of Ben Eastman, who is shown in the race in which he clipped a second from the record for the 440-yard run

SINCE a strong wind may alter an athlete's running speed by a fraction of a second, Stanford University officials have set up a wind recorder to verify the record-breaking performances of Ben Eastman, middle-distance ace. A four-mile-an-hour breeze is the maximum allowed during the setting of a record.

Eastman, shown in photo at left, a junior at the university, shattered a mark of sixteen years' standing by a full second last March when he ran 440 yards in 46.4 seconds, and those in charge of athletics at Stanford are taking no chances that the new records he is repeatedly setting may be questioned by the officials of American and international associations.

TAN-SEEKERS WEAR TRANSPARENT SUITS

SUN baths in transparent envelopes designed especially for the purpose are a new fad among California beach-goers. The novel wrappers, made of cellophane, are said to keep the sun's heat from warming the skin uncomfortably and protect the wearer from cold winds, as well. Ultra-violet rays, however, enter without difficulty, thus imparting the highly popular tan.

Clad in a transparent wrapper of cellophane, like a cigar, California bathers now get the tanning ultra-violet rays but escape the heat

RACK SERVES AS BRIDGE PARTNER

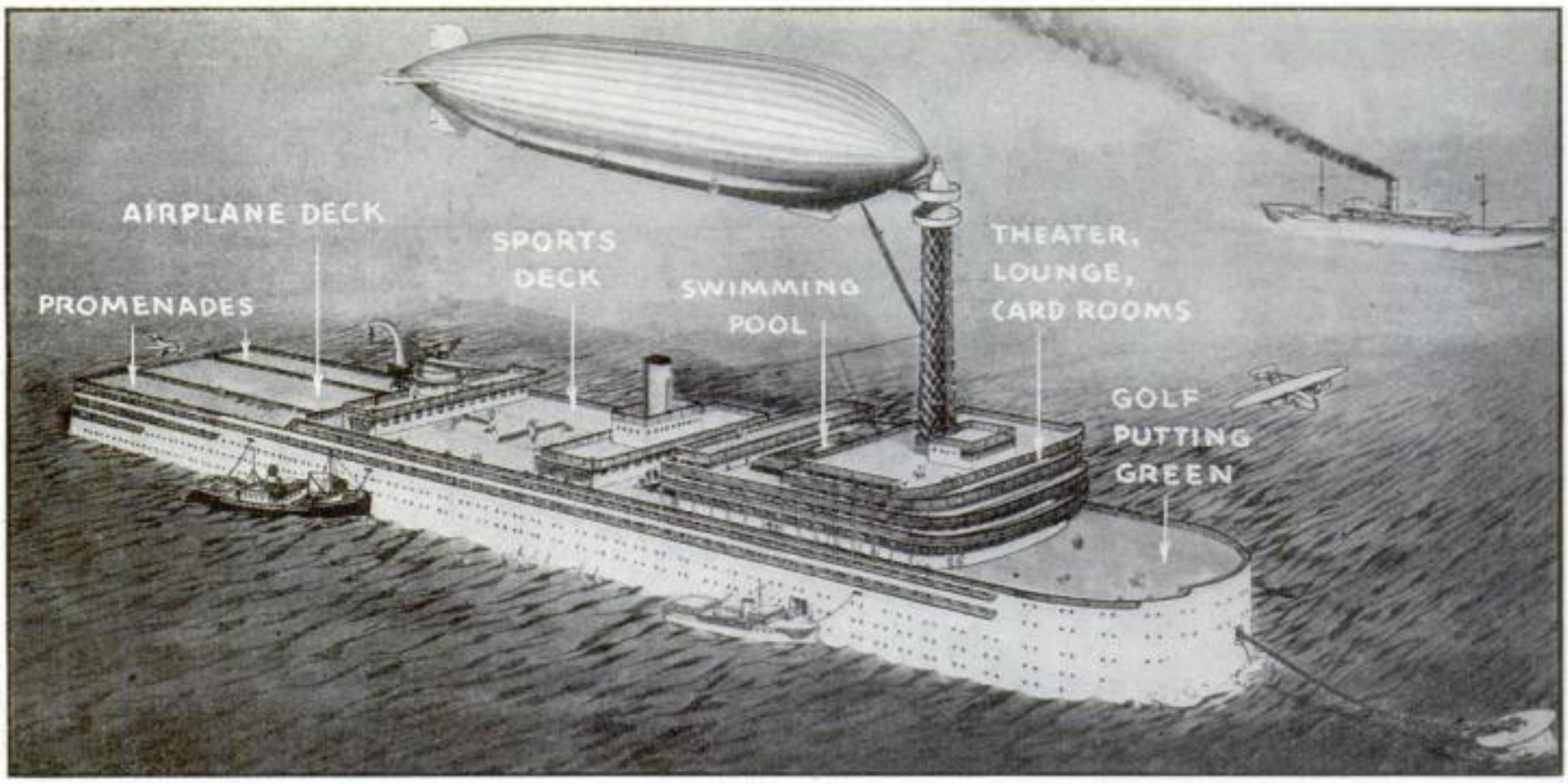
CONTRACT bridge partners that never criticize the bid or the play are the invention of a Los Angeles man. The "partner" consists of a wired rack in which thirteen cards can be placed. This support is set at an angle so that only the player sitting directly across from dummy can see the cards. With two of the supports, double dummy is possible with no necessity for picking the cards up to examine them or for improvising racks to hold them after bidding.

Double dummy contract bridge is possible with these wire racks to hold cards. Angle prevents opponent seeing hand

MONSTER FUSE BREAKS 13,200-VOLT CURRENT

BIG brother of the diminutive fuses that guard your household wiring is a foot-long monster recently designed by Westinghouse engineers. With little flame or noise, it interrupted a current of 20,000 amperes at 13,200 volts—a hitherto impossible feat—in a test made at the Westinghouse laboratories.

According to the designers, the secret of its ability is a thick core of solid boric acid crystals, surrounding a spring-operated plunger to which the fuse wire is fastened. When the wire is fused, the plunger snaps downward. The arc follows the retreating plunger into the hole it leaves and is extinguished by clouds of water vapor from the boric-acid crystals. By adopting a special design, the fuse can be used to interrupt small currents as well as large ones.



Big Floating Hotels to Be Moored off American Shores

FLOATING hotels or "oceandromes," 1,000 feet long and anchored forty miles or more at sea, may soon appear off the Atlantic coast. Plans to construct two such super-vessels have been announced by a Cuban syndicate, and their design has been completed by B. Poyntz Young, naval architect and marine surveyor of Brooklyn, N. Y. Each vessel will be managed as a clubhouse, open only to members, with tennis courts, shooting galleries, putting greens, and gymnasiums.

NEW CLOCK SHOWS TIME BUT HAS NO DIAL

TELLING the time is easy with a new clock that has no dial. Devised by a Pittsburgh, Pa., inventor, it shows the hour and minute by means of large figures like those of an automobile speedometer. Electricity drives the timepiece, turning drums on which the numbers are exposed one by one in the clock's window. Since the figures are easily visible across a room, the time is read at a glance without possibility of confusion. The inventor declares that he spent two years perfecting the complicated movement necessary for the mechanism that turns the drums.

USE LEAD-FILLED STRIP AS WINDOW PANE PUTTY

ANY home owner may easily replace a broken window pane with the aid of a new lead-filled strip that takes the place of putty. Secured with brads around the edge of the new pane, it makes an air-tight and permanent joint. The nails pierce the lead inside the strip to hold it securely in place. In addition, the new material may be used as molding around a sink or bathtub that has sagged away from the wall. It is also recommended for weather-stripping windows and doors.

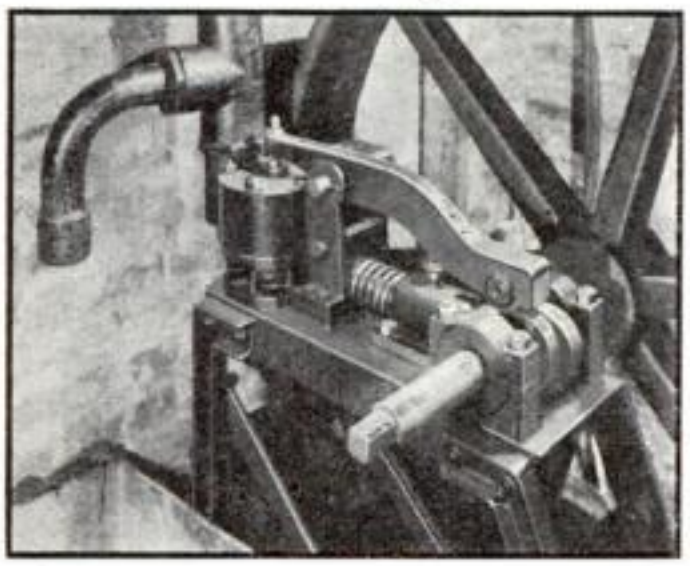
Window pane putty is quickly replaced with a lead-filled strip

RHYTHM INDICATOR HELPS MUSICIAN

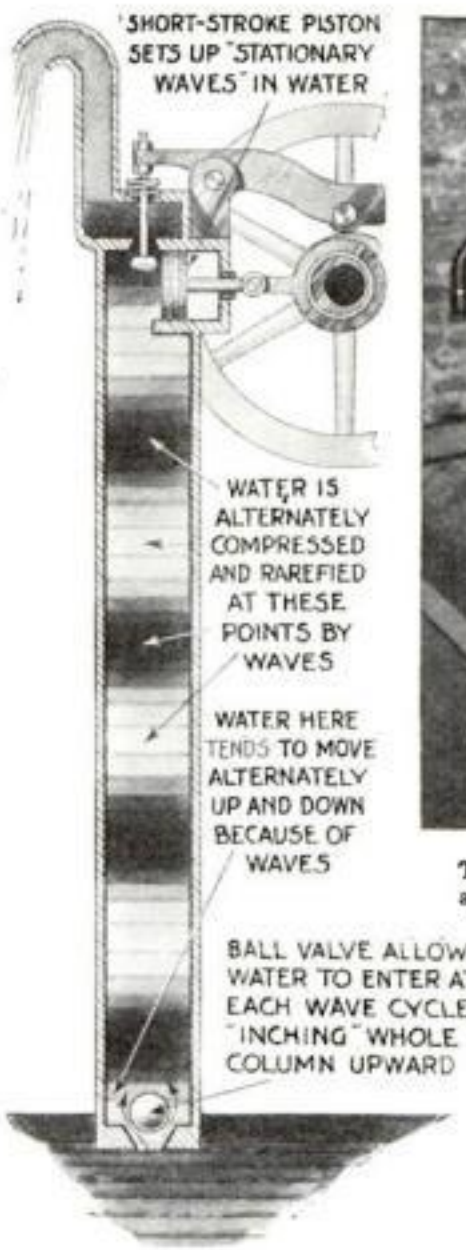
The rhythm indicator recently invented by Leon Theremin, by means of which sixteen beats can be blended to help a composer

A MUSIC composer may study the effect of blending different rhythms by using a remarkable electrical instrument that operates like a multiple metronome. When one of the pianolike keys is pressed and released, a low-pitched tone is heard in a loudspeaker at regular intervals. Pressing another key causes a new and higher pitched sound to be heard independently of the first. Sixteen beats may be produced at once. The device was invented by Prof. Leon Theremin, whose new electric musical instruments were recently described (P.S.M., June '32, p. 51).

New Pump Beats Natural Laws in Raising Water



Close-up of the wonder-working pump that draws water from any depth by utilizing compression waves, as is shown in the diagram at the right



Toribio Bellocq, Argentine inventor of the wave pump, assembling apparatus he used to get United States patent

FOLLOWING the example of the United States Patent Office, eighteen countries have issued patents to an Argentinian inventor upon an amazing pump that seems to violate natural laws. By creating waves in a pipeful of water, it makes the liquid run uphill.

When the inventor, Toribio Bellocq, applied for a United States patent on a pump to be mounted at the top of a well and to draw water up from almost unlimited depths, officials pointed out that his device apparently would have to defy the law of gravitation. Every high school student knows that by no effort can a pump *suck* water higher than approximately thirty-three feet. This is the limit at which the weight of an imprisoned column of water balances the atmospheric pressure outside. To force water higher from its source, authorities have always agreed that it must be *pushed* from below. Therefore Bellocq's "wave pump" seemed in a class with perpetual motion machines, which are not patentable because they are impossible.

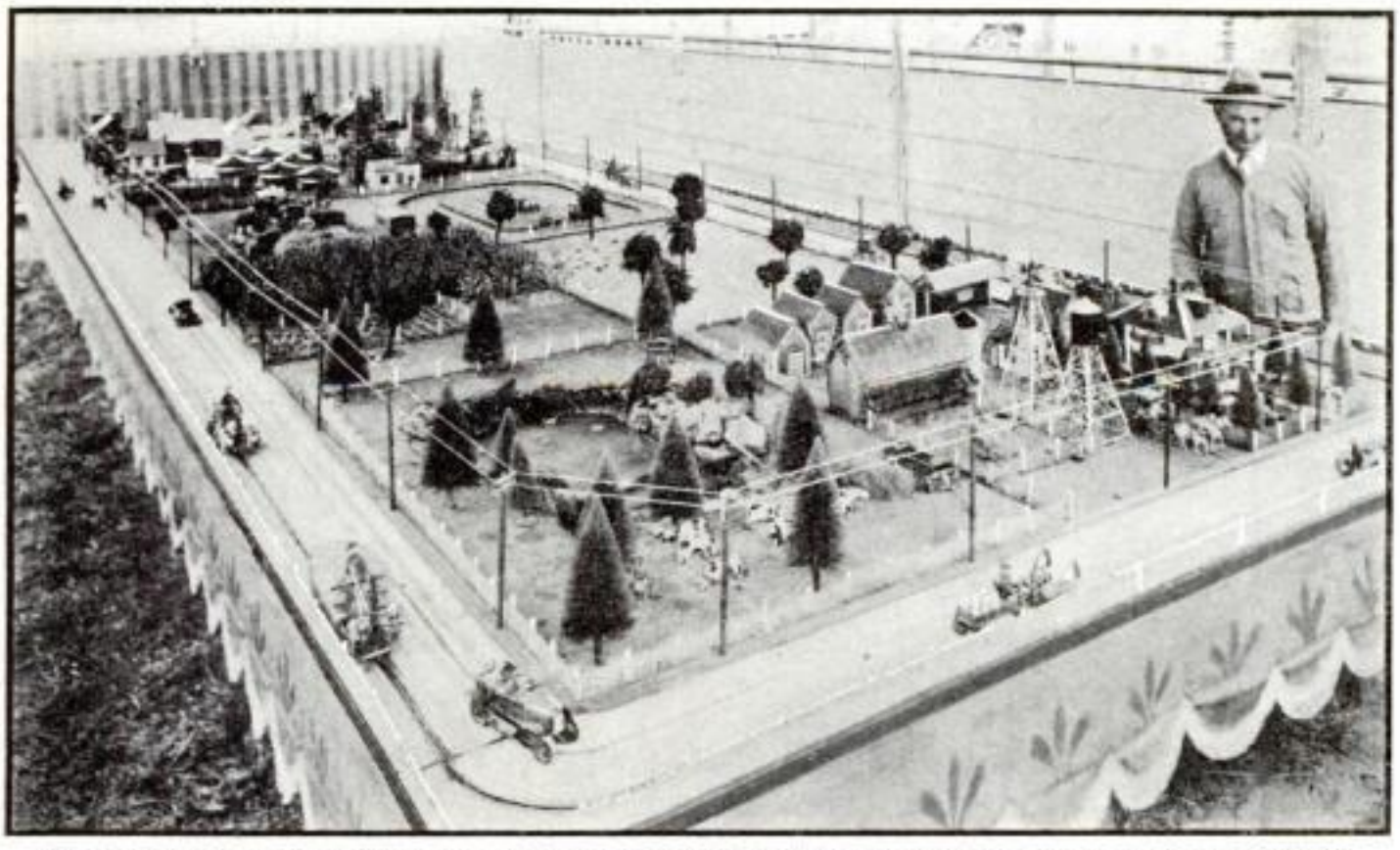
Bellocq built one of his pumps, installed it atop a Washington, D. C., office building, and invited officials to inspect it. They saw it draw a steady stream of water up a pipe eighty feet high. Not until they dropped weights down the pipe and found no unseen machinery did they believe their own eyes. Then they acknowledged that Bellocq had chanced upon an entirely new mechanical principle and issued his patent.

So extraordinary is the operation of the new wave pump that even Bellocq admits he is not certain of its principle, and leaves to scientists the verification of his own explanation.

In Bellocq's pump a piston vibrates rapidly with an extremely short stroke. It deals hammerlike blows to a column of water in a pipe. His theory is that when the frequency of the blows is properly timed for the length of the pipe, a series of "stationary waves" is set up.

Suppose the pipe's bottom to be closed; then layers are formed where the water is alternately rarefied and compressed, without moving. Midway between these and at the bottom are regions where water rushes alternately up and down because of the waves.

When a one-way ball valve is added at the bottom, water enters from outside at one point in each wave cycle, to replace water moving upward from the bottom of the pipe. Once inside, it cannot back out. Every influx of water "inches" the whole column upward, without interfering with the waves that travel through it. A valve at the outlet, while not essential, improves the efficiency.



Model of an American farm scene, containing over 7,000 working parts and valued at more than $10,000

FARM MODEL HAS 7,000 PARTS

Two BIG trailers are required to transport one of the most ambitious models ever built. The exhibit, thirty-two feet long, depicts an American farm scene, a blacksmith shop, and an oil field, electrically illuminated and with animated figures driven by electricity. It represents the result of fourteen years of painstaking labor on the part of Joe Teska, former chief engineer of a Winona, Minn., paper mill. Now he and his family tour the country exhibiting his model at country fairs. According to Teska, it contains 7,000 working parts, and is valued at more than $10,000. Typical figures are a threshing crew and a blacksmith shop.

Cheap Process Yields Plants' Magic Substance

ONE of the world's most mysterious substances, chlorophyll, the life-giving green pigment in the leaves of plants, is now available to science and industry. Dr. Frank M. Schertz of the United States Department of Agriculture has found a way to extract it at low cost from blue grass, spinach, and other plants, and has obtained the largest batch of the pure compound ever isolated.

With plenty of chlorophyll available for study, experts hope to explain a long-standing riddle. Sunlight falls alike on man, animals and plants, but only the plants have the power of harnessing its energy to manufacture food. The chlorophyll in their green leaves, in some way still unknown, takes carbon dioxide gas from the air and transforms its carbon into sugars and starches; yielding oxygen in return, through the pores of the leaves. New studies of chlorophyll may reveal the secret of this process.

Commercial applications are also foreseen for Dr. Schertz's discovery. Chlorophyll already is used in soap manufacture and other industries. Medicinal pills are made from it. Hitherto Germany and Switzerland have furnished small quantities, extracted at almost prohibitive cost. With a cheap supply available, Dr. Schertz foresees new uses. One derivative of chlorophyll, he says, offers great promise as a beneficial coloring for ice cream.

1 Chlorophyll is now being extracted on a large scale by the Government. The first step in the new process is drying leaves for twelve to twenty-four hours in an oven

2 The dried leaves are placed in a "ball mill" and ground with stones until they are reduced to a fine powder. The nose guard protects the operator from dust

3 Into the large funnel, right, goes the leaf powder to which various chemicals are added. The resulting mixture contains chlorophyll and in addition other leaf pigments in a concentrated form

4 Next, the solution of chlorophyll is dumped into a centrifuge and whirled to remove impurities. In this way a solid mass of chlorophyll is gathered in bowl

5 The mass shown above is the largest quantity of chlorophyll ever isolated at one time. In the process of extraction the chlorophyll loses its greenish color and becomes blue-black

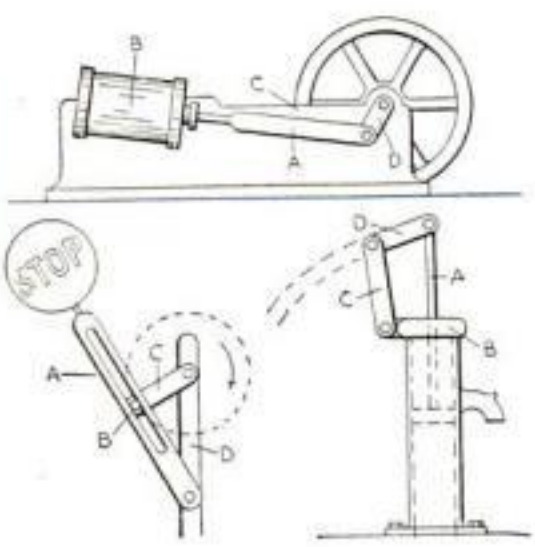
6 Here is a close-up of chlorophyll in three main stages. First the leaves, next the powdered substance, and last the chlorophyll itself. It takes about 200 pounds of leaves to make one pound of extract

Can You Invent It?

HERE is a situation in which the man in the boat must become an inventor in order to save his life! He was rowing across a river only a couple of miles above a high waterfall when one of his oars slipped out of his hand and went overboard. In the boat he has an anchor and over two hundred feet of rope, but the river is too wide for him to throw the anchor to the bank. How does he reach the bank with the means at hand? A condition of the problem is that he does not scull or paddle the boat toward shore with the one remaining oar.

• • •

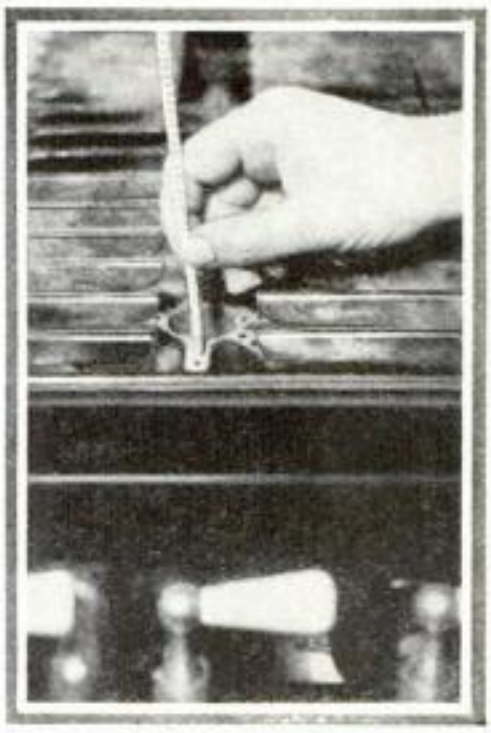
These three diagrams show how the four mechanical members of the reciprocating engine (shown last month) can be rearranged to form three new mechanisms. In the reciprocating engine, part *A* was fixed; *B, C, D* were movable. In the oscillating cylinder engine (Fig. 1) *C* is fixed, while *A, B, D* move. In the crossing signal (Fig. 2) *D* is fixed; *A, B, C* move. *C* is shortened, *A* is lengthened, and the position of its slit is changed. In the hand pump (Fig. 3) the steel block *B* is pierced and enlarged. It is fixed, and *A, C, D* move. *D* is extended to form the pump handle.



Study of Fig. 1, at top; Fig. 2, at left; and Fig. 3, at right, in connection with text, gives answer to last month's problem

New Uses *for* Old Utensils

MATERIALS at hand in almost every home, though not to be found in the average tool kit, will simplify many a household task. The photographs on this page suggest eight handy kinks that may save time or labor in everyday life. They illustrate how familiar utensils often may be well adapted to uses that the manufacturer, or the householder who has used them for years, never thought of, and that wait for some ingenious tinkerer to discover.



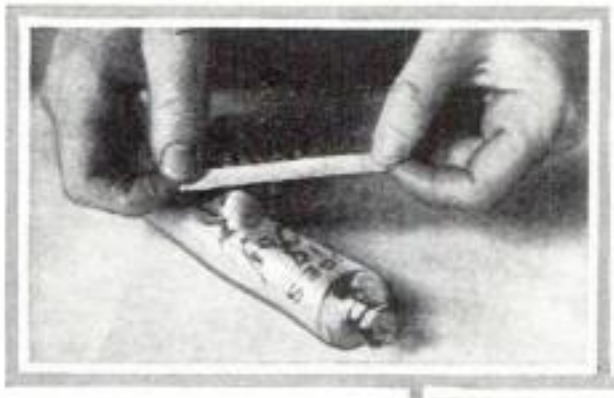
A NEW ONE FOR PIPE CLEANERS

When the holes in a gas stove burner become clogged, pipe cleaners can be used to open them with little effort

STRING HOLDER. The kitchen funnel can be forced to serve a purpose for which it was never intended and be used as a string holder. Hung on the wall it keeps twine always ready for use

GUARD THE HATBAND. A strip of wax paper placed in a hat, as shown at left, will protect the hatband from all sweat stains

KEEP THE CORK IN. Before putting bottles in your traveling bag secure the corks carefully by placing adhesive tape over them



NEW USE FOR TAPE. When a paste tube bursts, it can be mended easily with a bit of adhesive tape wound so that it fully covers the break, thus stopping waste

MAKE YOUR COAT HANGER

If you find yourself without a coat hanger you can make one out of newspaper by rolling the paper and attaching a string to hang it up with

SPREAD PASTE WITH SCRAPER

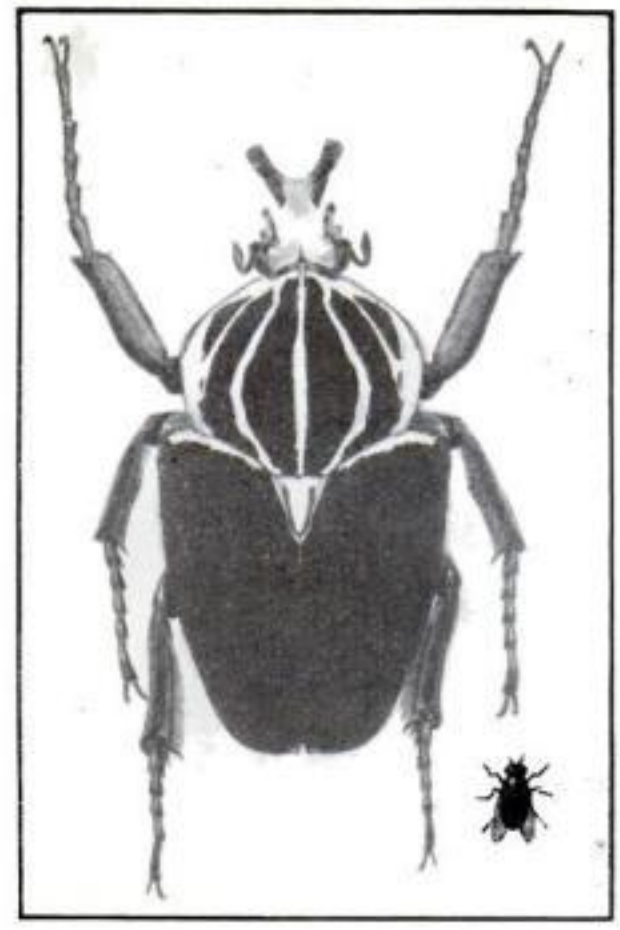
If a large surface is to be covered with paste, you can speed the work by using a plate scraper to smooth out the paste

DARN WITH FLASHLIGHT. In an emergency, you can use your flashlight as a darning form, the light making the work easier on the eyes, especially during the evening

COTTON PICKER DOES WORK OF 60 MEN

Machine, with revolving cogs, picks cotton as fast as sixty hand laborers could do it

WILL the cotton pickers of the South give way to more efficient, if less romantic, harvesting machinery? An improved cotton harvester, exhibited recently in Chicago, supplies the most recent threat to the continued use of hand pickers. When it passes over a field of stalks, cogs revolve and pick the cotton as neatly and thoroughly as human hands can do it. Such is the speed of the machine that it is said to do the work of sixty men. As it is equipped with headlights, the harvester can be used after dark. A wealthy Chicago manufacturer, it is claimed, employed his spare time for six years, and expended half a million dollars, in developing the new invention.



BIGGEST BEETLE KNOWN IS FOUR INCHES LONG

TWENTY fine specimens of the brown Goliath beetle of equatorial Africa, largest of the 100,000 known species of beetles in the world, have just been received by the Field Museum of Natural History in Chicago. The body of this insect is nearly four inches long. When it flies, the sound of its wings resembles the hum of an airplane propeller. The photograph above shows it about half-size, with a common house fly beside it for comparison. The big beetle is harmless, and feeds on sap.

GET HEAT AND MASSAGE FROM ONE MACHINE

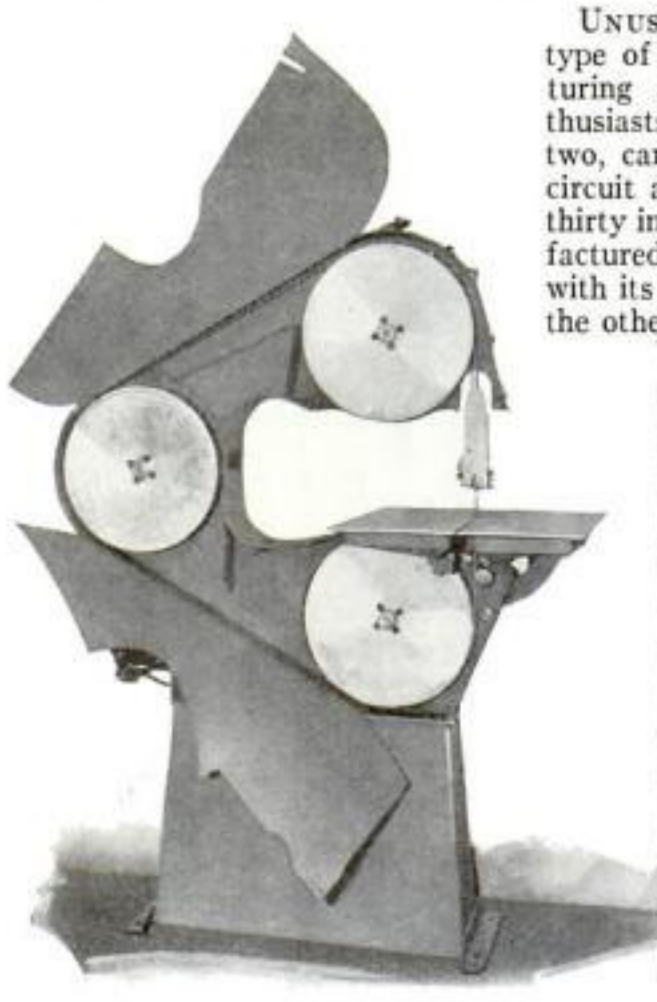
HEAT, massage, and vapor treatment are combined in a new electric instrument designed for external use in treating local congestion and irritation due to colds and other ailments. When it is plugged into a wall socket, a circular heating element vaporizes any preparation with which its gauze applicator is saturated. A light grip on the handle enables the user to massage the chest conveniently. An adjustable control regulates the heat, and the gauze is easily changed.

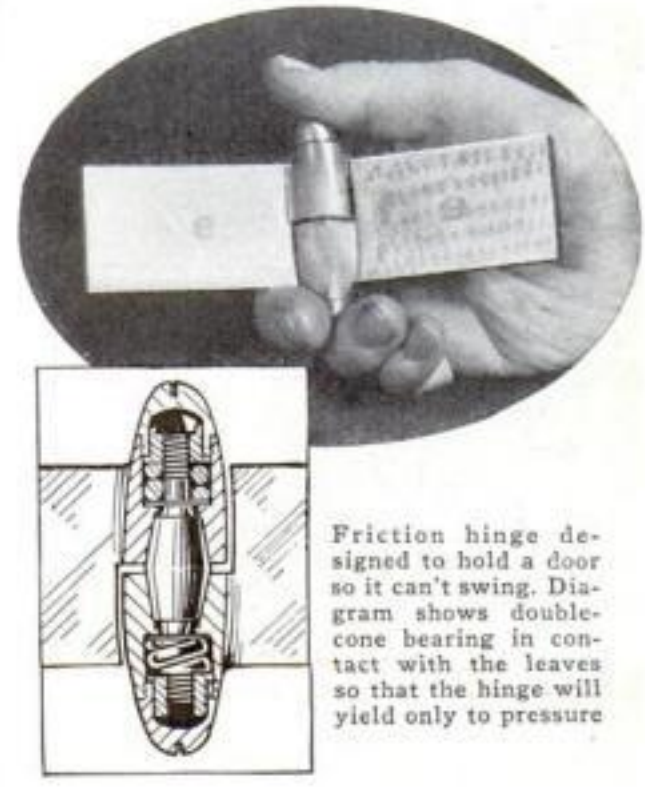
THIS FRICTION HINGE HOLDS DOOR OPEN

SO OPEN trunk lids will not fall down, and doors will remain open without swinging, a friction hinge has been devised. Its bearing is a double cone, held closely by springs in contact with the two leaves. A door or other object fitted with the hinge will stay open until sufficient pressure is applied to overcome the friction of the bearing. The necessary pressure is predetermined and is stamped on each hinge.

NEW BAND SAW HANDLES BIG PIECES

UNUSUALLY large work is handled by a new type of band saw for school use, light manufacturing and for advanced home workshop enthusiasts. Three wheels, used instead of the usual two, carry the flexible blade around a triangular circuit and permit clearances of twenty-four and thirty inches respectively in the two models manufactured. One of the photographs shows the saw with its guard unfolded to reveal its construction; the other, with the guard in place.

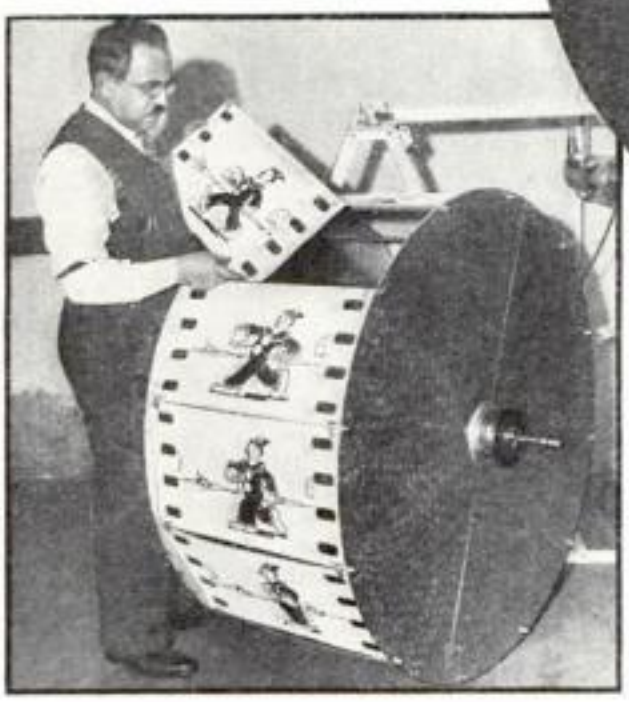




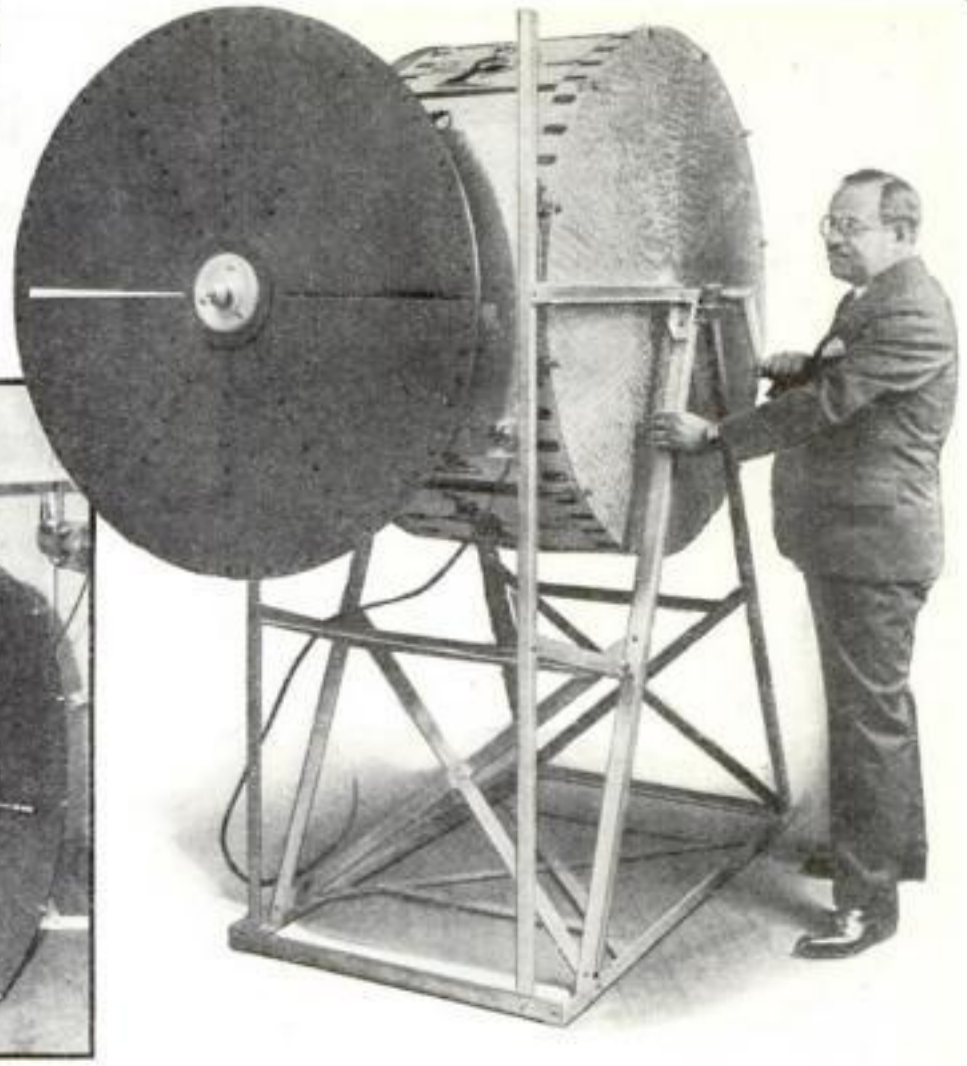
Friction hinge designed to hold a door so it can't swing. Diagram shows double-cone bearing in contact with the leaves so that the hinge will yield only to pressure

HOW MOVIE CARTOONS WORK

A REVOLVING-DRUM device now being installed in department stores and elsewhere as a mechanical novelty displays a brief animated movie that constantly repeats itself. It is designed to explain to the layman how the intriguing animals and human figures of cartoon strips in the motion pictures are given the illusion of motion, by superimposing in quick succession a number of drawings differing slightly in detail. The machine was invented by Max Fleischer, movie cartoonist. An unusual mechanical feature of its construction is a revolving-disk shutter that makes it possible to keep the wheel with the pictures turning at uniform speed instead of intermittently in the fashion of standard movie projectors. The spectator views the movie through the right-hand slit in the disk shown in the photograph.

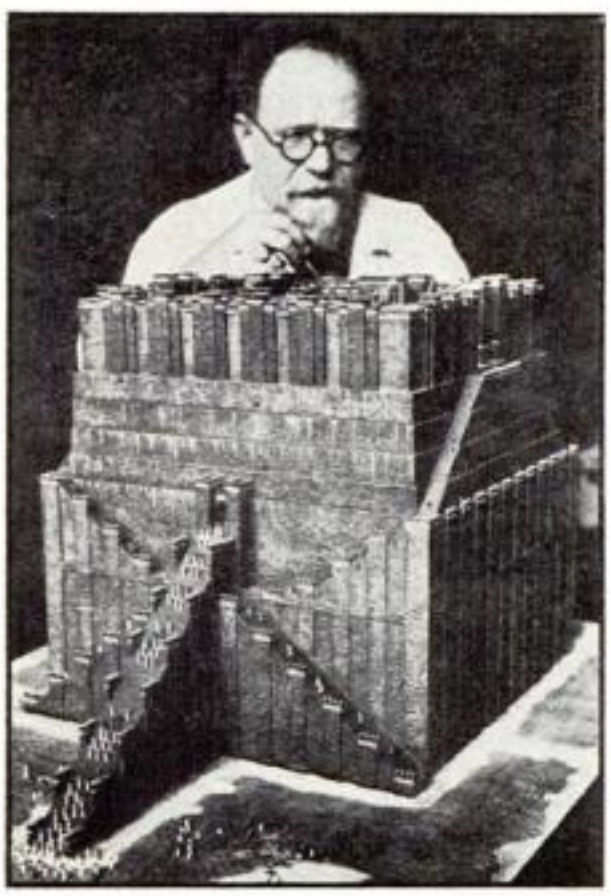


Below, the revolving drum upon which are figures to show how animated movie cartoons are made and operated. At right, apparatus ready for use. Moving figure is seen through disk's slit



TOWER OF BABEL MODEL MADE FOR CHICAGO

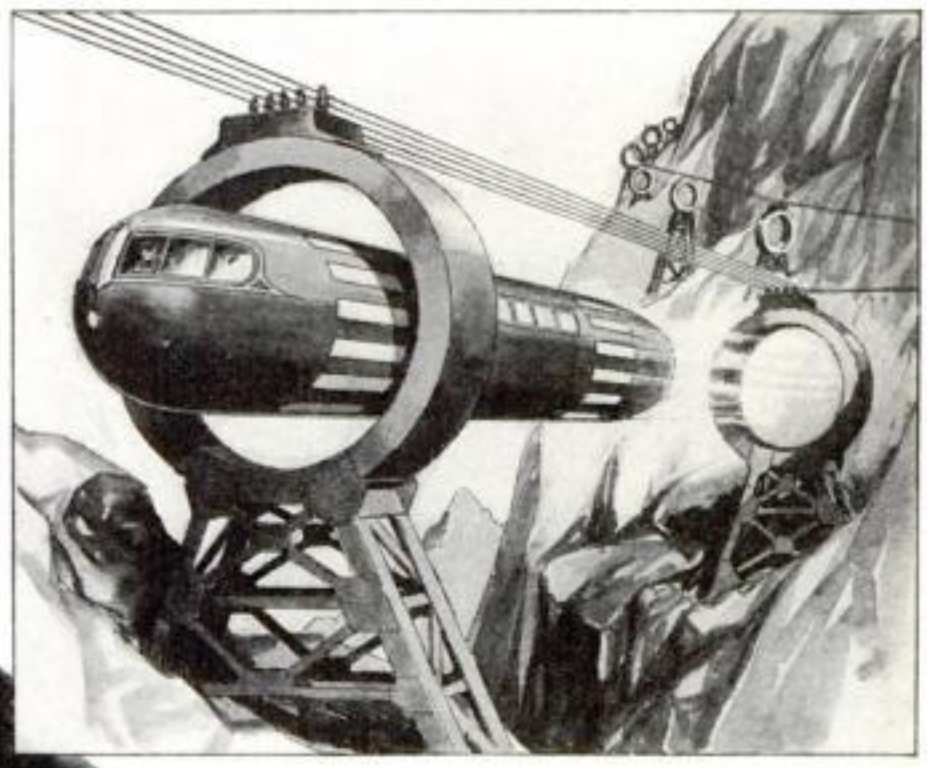
A MODEL of one of the world's first skyscrapers, the Tower of Babel, famed in Biblical story, has just been completed by a German sculptor for the Oriental Institute at Chicago, Ill. It depicts in faithful detail the tower at Babylon on which the legend is believed to have been founded. According to this story, the plan was literally to build a "skyscraper," for the tower was intended to be raised until it reached heaven. The legend declares that the intent was frustrated when the builders' speech became miraculously confounded; whether this or some other hindrance interfered, the tower actually reached a height of only 300 feet.

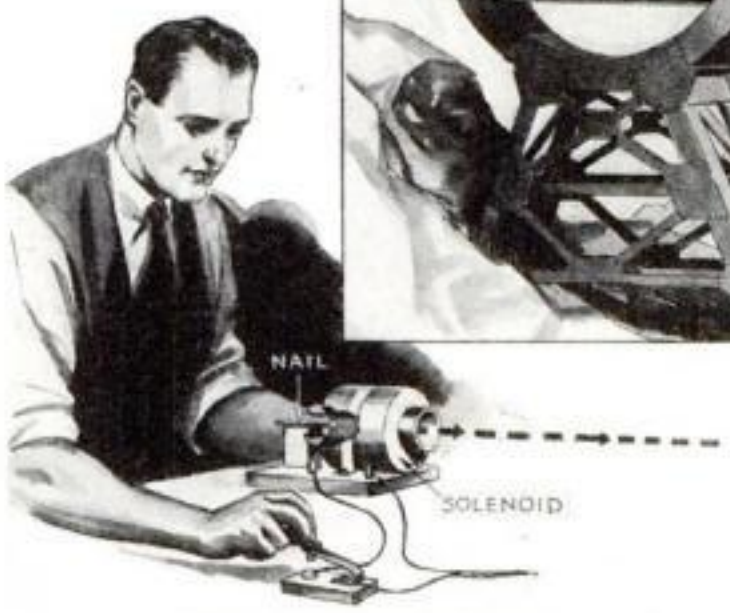


Accurate, detailed model of the Tower of Babel made for Oriental Institute of Chicago

PLAN BLIMP FOR MAGNETIC AIR LINE

This magnetic air line, along which metal blimps would be shot by magnetic power under automatic control, is being planned and developed in Germany. Below, experiment with nail to show principle of magnetic propulsion





ALL-METAL "blimps" sustained by hydrogen or helium and propelled by giant magnets along a predetermined route are suggested by a group of German inventors, who are studying the feasibility of such a plan for a line across the European Alps. Their idea is based upon a simple experiment which anyone may perform for himself. When an iron nail is placed in a tube just behind a solenoid, or coil of electric wire, and the circuit closed for a fraction of a second with a key, the nail is shot through the coil by the power of magnetism.

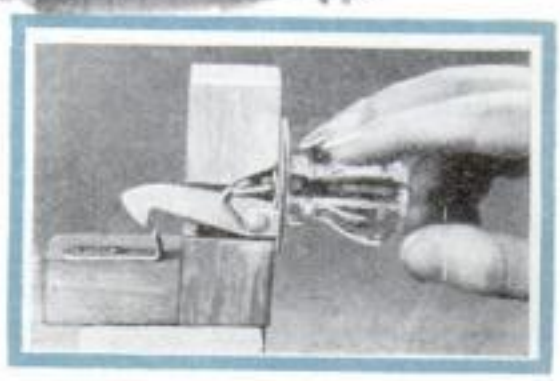
In the proposed high-speed line, the motorless blimps would be similarly propelled by the magnetic force of monster solenoids acting on their iron framework. To turn on and shut off the power of each solenoid at the proper instant, photo-electric cells would be set up at regular intervals to detect the passage of the car and actuate the magnets automatically. Because of the limitations of load that could be carried, each car would accommodate only a few passengers, but the high speed obtained by the streamlined vehicles would justify the charging of an extra fare and make such a service profitable, the inventors believe. All friction but that of the air would be eliminated, with consequent economy of power. Although a pilot with auxiliary control apparatus would be stationed in each car in case of emergency, its movement along the magnetic air line would normally be controlled by a dispatcher at a distant point.

INVENTIONS *for*

VACUUM DRY CLEANER. A miniature dry cleaning outfit for the home that removes grease spots from clothes. Its applicator pad draws cleaning fluid from small reservoir, returning it by valve system that uses suction

UMBRELLA OR CLOTHES DRYER. At left and below are two views of the same thing. In one it is a decorative garden umbrella in which there is no hint of its utilitarian possibilities. In other picture, it is seen as a practical clothes dryer of rustproof metal with space for many garments

TWO IN ONE. Fruit juice is squeezed out over the grooved and pointed end of this mallet, the juice running down into dish in which mallet is placed. The mallet, made of hard wood, can be used to crush ice. It is easily cleaned and occupies little space when idle



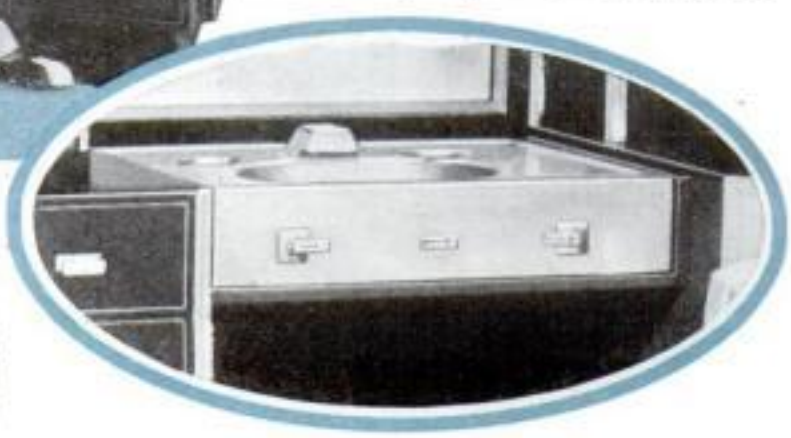
HOLDS CUPBOARD DOOR SHUT. There is little danger of cupboard doors swinging open if they are equipped with this latch. Moving the knob in any direction releases latch and door opens

EASY WORKING JAR TOP. Here's something new for your mayonnaise jar. The close-fitting top is equipped with a hinge and pressure of the thumb on the trip raises top

MORE THAN A DRESSING TABLE. This piece of furniture is a dressing room convenience that should save steps and time. It is a dressing table with space for linen, towels, cosmetics, and personal accessories. It also has a hidden washbowl disclosed by raising the table top, as shown at the right

PROTECTS THE TABLE. A glass set on this rubber coaster is held securely by a vacuum cup while the coaster's rim catches any drops that run down the side

GETS RID OF DIRT. The boxlike attachment, shown above, is for a vacuum cleaner. By merely raising the cleaner bag, the accumulated dirt falls into the box, which is easily emptied



the Household

CHARCOAL COOKER. With the grill shown below it is possible to cook for the home epicure meat to which has been imparted the aroma and flavor possible only with a charcoal fire. In the heavy container beneath the broiling grill, charcoal is placed and the meat cooked in its heat

LIGHTWEIGHT CLOTHES WASHER. No motor runs this clothes washer, but by an ingenious arrangement it is operated by the vacuum cleaner which attaches to the device seen at right and through which air is blown to agitate the water. It weighs five pounds and is used at cost of current to run cleaner

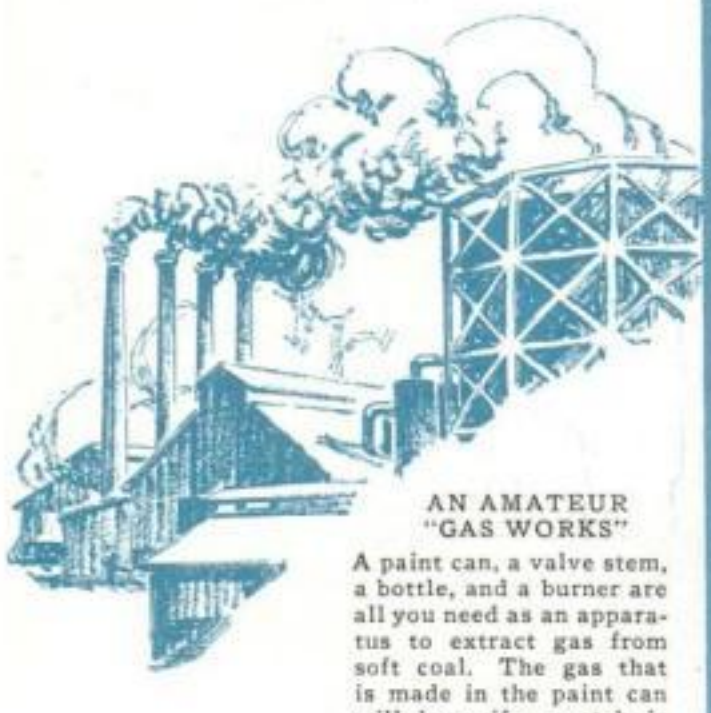
COMBINATION SLICER. The use of bread and meat knives is eliminated with this circular slicer which cuts bread, meat, cheese, or fruit in slices of uniform thickness and does the work quickly. Clamped to kitchen table, it occupies little space

ICE COLD WATER. Clear glass bottles, with a cut design, are now available as water bottles for the refrigerator. Provided with nonleakable tops, they keep water cold without ice

PROTECT YOUR PLANTS. Insecticide for household or garden use is now furnished in a container that is also a bellows duster as seen in the picture at left. To use it, a rip cord is pulled and a small sealed hole punctured. The two parts of the package are then worked exactly like a bellows

CLEAN AND COLD. Below and at right are views of a milk bottle holder into which the milkman is expected to place the daily supply. It will hold three bottles and is insulated to keep the milk cool while lid guards against dirt

SEWING KIT. The outfit, right, was invented by a woman to keep thread, thimble, and scissors always handy. The thread, mounted on spindles, is drawn as required through holes in the side of the compact case. By this arrangement it is impossible for thread to snarl



AN AMATEUR "GAS WORKS"

A paint can, a valve stem, a bottle, and a burner are all you need as an apparatus to extract gas from soft coal. The gas that is made in the paint can will burn if a match is held close to tube end

Industrial Stunts *for*

With copper sulphate, household ammonia, and water, the stalactite form seen in beaker at left will grow while you are watching it. The process is one found in Nature and accounts for the interesting formations seen in many natural caverns

By Raymond B. Wailes

INDUSTRY today, in virtually all of its most important and profitable branches, leans heavily upon chemistry. So numerous are the chemical processes now used by manufacturers that only a few of them can be touched upon in this department. However, certain chemical operations are so basic in their nature that out of them have grown a host of secondary processes. Several of these primary experiments are given here and fortunately they are of such a nature that they can be performed easily in your home laboratory.

The first two or three mentioned below have no industrial application, but as the process of precipitation has wide practical use, it will be interesting and advantageous for you first to try your hand at these experiments which are beautiful though they may have no commercial value.

Here is one you can do in about ten minutes. All you need is a teaspoonful of household ammonia or ammonia hydroxide, a large drinking glass, a few crystals of copper sulphate, frequently called bluestone, and a five-inch square of bronze insect screen. The crystals of copper sulphate should be broken to a size just a little larger than the mesh of the screen.

Fill the glass nearly to the top with water as shown in picture at left center and add a teaspoonful of ammonia. Then form the square of screen into a cup shape with the lower portion slightly below the surface of the solution. Place ten or twelve copper sulphate crystals in the hollow of the screen.

Action starts almost at once, and by the end of five minutes you will see a slowly growing stalactite formation stretching down into the solution from each copper sulphate crystal.

The stalactites are solid copper hydroxide. As the copper sulphate crystals dissolve, they combine with the ammonia water to form copper hydroxide. Because it is a solid, the precipitate hangs together, and more copper sulphate trickles down to make more hydroxide.

The action is especially interesting because it shows, in a general way, how many queer natural formations occur. Icicles, for example, are produced like this except that the action is physical (freezing), not chemical.

Another interesting test can be performed with the same apparatus. Fill the beaker with plain water. Place crystals of potassium permanganate in the hollow of the screen. The water should be allowed to stand until it is absolutely still before adding the permanganate. Curious snakelike formations will be produced. They are not permanent nor is any solid substance formed.

A BEAUTIFUL crystalline growth, often called the Lead Tree, or Tree of Saturn, can be made with aid of a wide-mouth bottle, a strip or rod of zinc, and a solution of lead acetate (sugar of lead). A good working strength for the solution will be a tablespoonful of the lead acetate dissolved in half a pint of hot water.

After the solution is prepared, polish the zinc strip with a piece of sandpaper or emery cloth until it is clean and shiny. Place the zinc in the bottle after passing the end of it through a slot cut in a cork. It need not fit air-tight. The zinc should extend nearly to the bottom of the bottle.

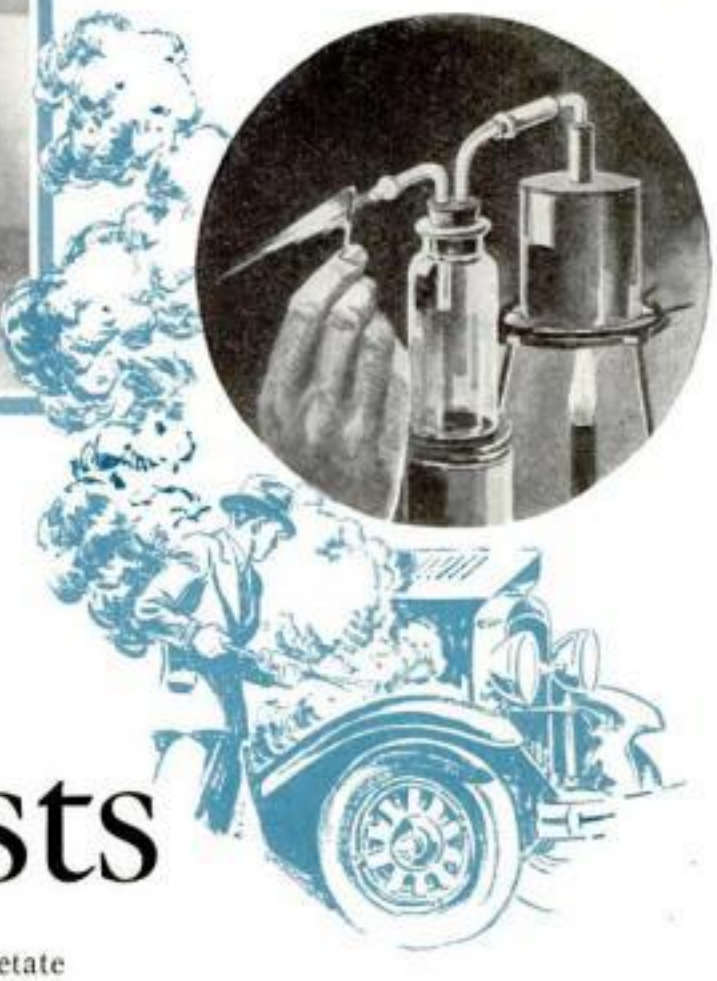
Let the bottle stand overnight and the next morning you will observe a delicate, crystalline growth coating the zinc as is seen in the picture at top of opposite page. It will continue to increase in size for several days. The effect is produced by chemical action. The zinc drives the lead out of the lead acetate solution and forms zinc acetate, the metallic lead appearing as lead crystals.

A similar reaction is widely used in machine shops by tool and gage makers as an aid in laying out fine lines on steel or iron parts. They take the piece of steel or iron and immerse it for a short

The experiment above shows the process of dyeing by precipitation. A strip of white cloth is soaked in lead acetate and while moist immersed in a chromate solution. Lead chromate precipitated into the cloth will turn it a bright yellow

Using a wide-mouthed bottle, a strip of zinc, and a solution of lead acetate, the Tree of Saturn, at left, can be grown in your "lab"

Carbon dioxide gas, produced by heating marble chips in a retort, is the gas with which ginger ale is charged. If a lighted match is held in the gas as it comes from the tube, the flame will be extinguished. This shows how chemical fire extinguishers operate and why they are so effective



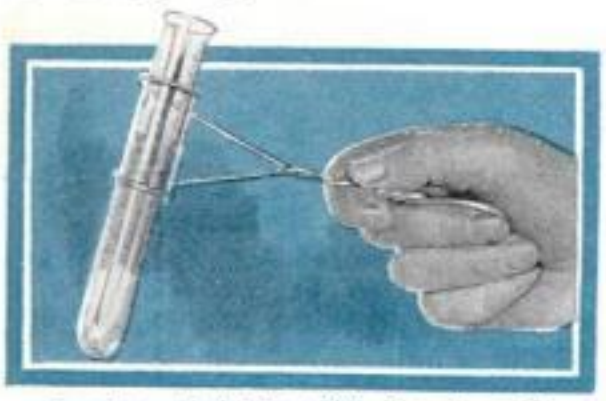
Home Chemists

time in a solution of copper sulphate. A minute quantity of iron goes into solution, forming a sulphate of iron, and a corresponding thin layer of copper is deposited on the steel or iron part. Lines scribed on this thin plating of copper show very clearly.

TRY this experiment with a knife blade, an iron nail, or any piece of scrap iron and note how quickly the characteristic copper color appears on the surface of the metal. If the iron is allowed to remain in the liquid, the intense blue color of the liquid will fade out as the copper leaves the solution. Copper plating done by this method is not permanent, as the copper is held only loosely and is easily rubbed off.

There are many other experiments where precipitation, which is the technical name for such reactions, is employed.

For example, you can perform a striking test with the lead acetate and potassium chromate solutions. First soak a strip of plain white cloth in the lead acetate. Then, while still moist, immerse it in the chromate solution. Yellow lead chromate will be precipitated into the fibers of the cloth, turning it a bright yellow. This illustrates the procedure of dyeing by precipitation.



A piece of fairly stiff wire is easily twisted into this handy test tube holder

If you mix the chromate and acetate solutions, a yellow precipitate forms and settles to the bottom. You can separate the yellow powder from the solution by filtering. The yellow material should be washed by passing plain water through the filter to remove the remains of the mixed solution. Then, if the filter paper is allowed to dry, the yellow lead chromate can be scraped off and preserved.

Lead acetate can be used for another interesting experiment. Mix a portion of it with a solution of potassium iodide. A precipitate of yellow lead iodide forms at once. If the entire solution, including the precipitate, is heated, the latter will dissolve in the boiling liquid. Allow the solution to cool and golden-colored crystals of lead iodide will form.

AN interesting chemical garden, which can be grown overnight, can be made by dropping small crystals of copper sulphate, cobalt chloride, iron sulphate, lead acetate, nickel sulphate, or almost any compounds of the metals mentioned in a container of water-glass solution (sodium silicate). The chemicals will dissolve and form precipitates, which grow, as in the copper sulphate-ammonia water experiment, to form curious shapes.

Distillation is another much used chemical process. It serves both to separate mixed substances that cannot be separated by other simple means and to convert one substance into another while the distillation is going on.

A lump of soft coal, for example, contains a whole list of things beside carbon. By distillation, these various substances can, to a large extent, be separated one from another.

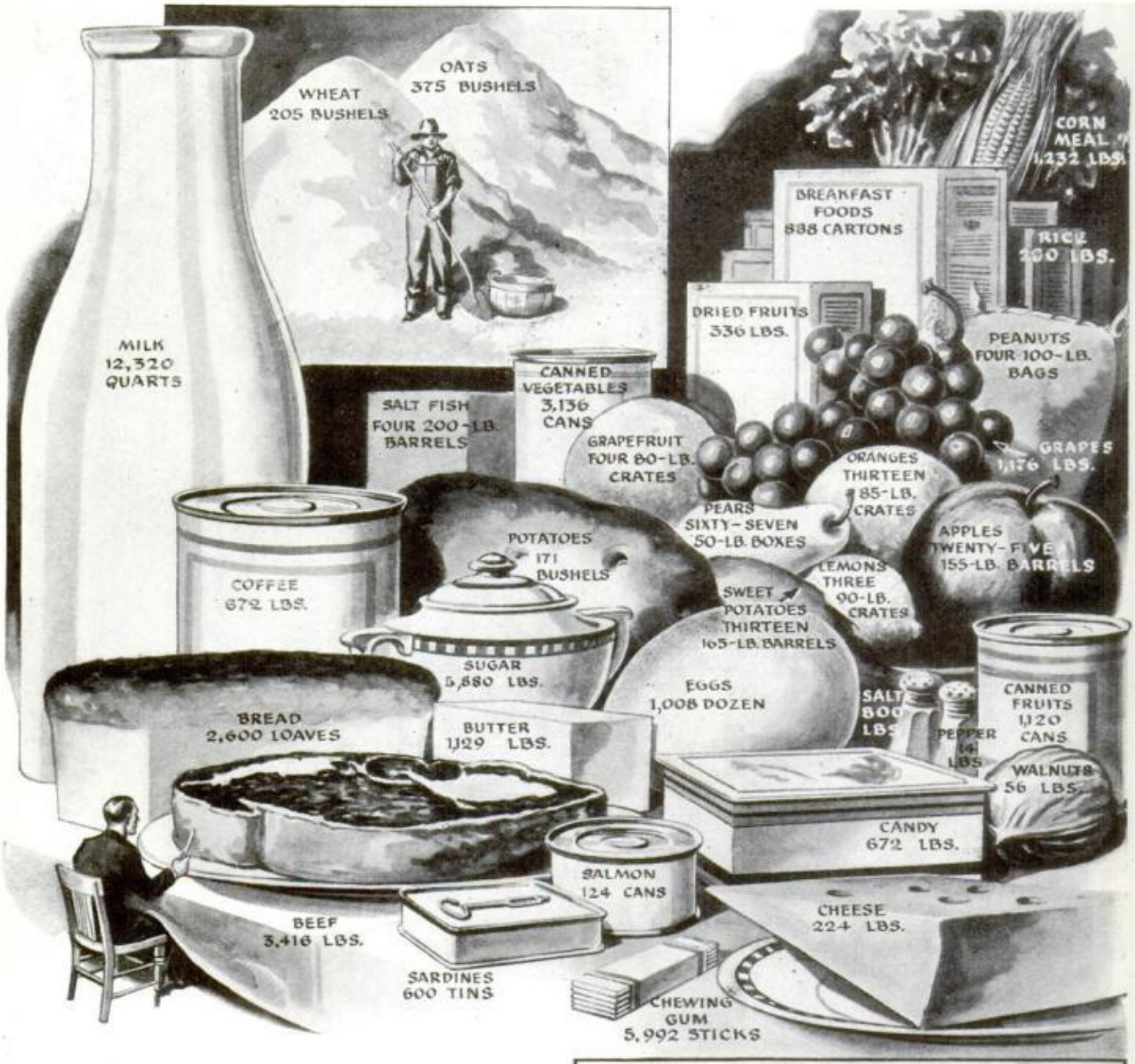
You can experiment with the distillation of coal quite easily. All you need is the simplified retort shown at the top of page sixty. A paint can, with a discarded tire valve stem fitted to the snap cap, serves as the heating chamber of this miniature "gas works." The output of the retort is piped to a glass bottle as shown.

ALTHOUGH the "gas works" will function with any kind of coal, soft coal is better than anthracite, which contains relatively little gas and other products in addition to the carbon. After the flame has been burning for a few minutes, a brown gas will come out of the outlet pipe of the bottle. If you apply a match, the gas will burn. The brown color is due to the tarry vapors and droplets formed by the chemical decomposition of other portions of the coal. A colorless gas could, of course, be obtained by passing it through a piece of tubing containing mineral wool or asbestos fibers that would filter out the solid or liquid impurities. After a while you will note several drops of liquid in the bottle. Test it with a piece of red litmus paper. The paper will turn blue, proving the presence of an alkali, which in this case is ammonia.

Your miniature gas works set-up can be used to make lime from limestone and produce carbon dioxide gas in the process. Marble chips are chemically the same as limestone, called calcium carbonate.

Fill the retort with marble chips and apply the heat. The heat breaks down the calcium carbonate to form lime (calcium oxide) and carbon dioxide gas. This is the gas used to provide the bubbles in charged waters, ginger ale, and other beverages. It will not burn and has no color. If allowed to blow on a burning match it will snuff out the flame. It does this by cutting off the supply of oxygen, and the test shows why chemical fire extinguishers are so efficient.

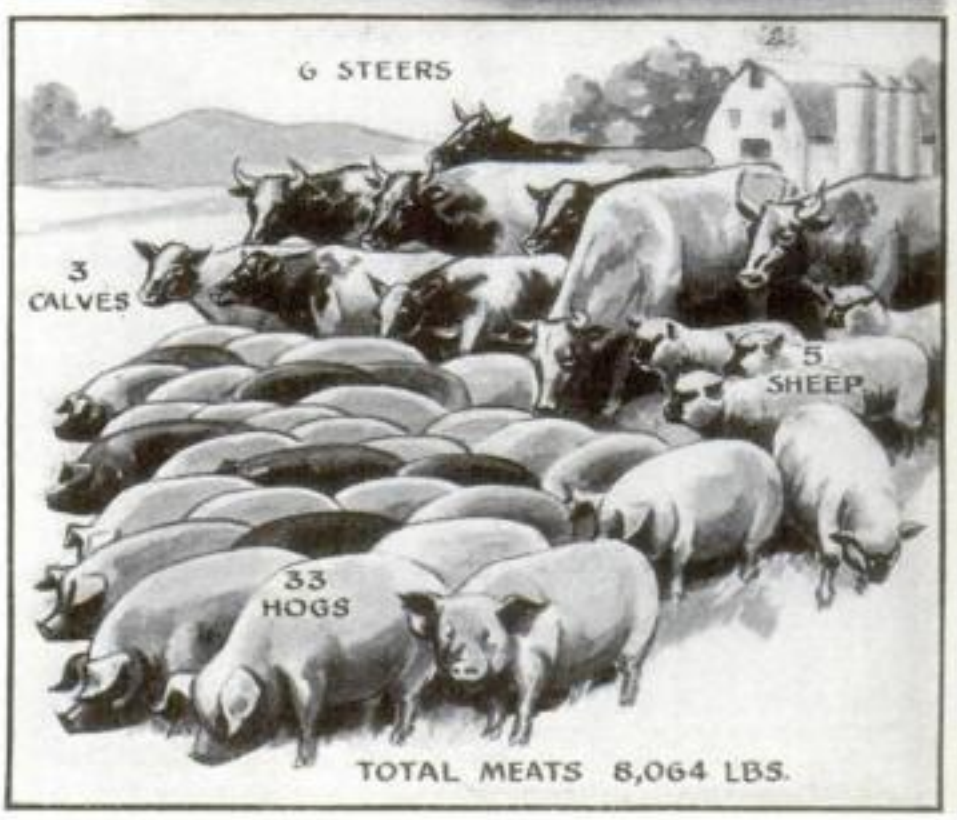
You Eat Giant's Meal *in* 56 Years



IF YOU were served at a single meal all the average person eats in a lifetime, you would sit down to a beefsteak weighing as much as six dressed steers, confront a giant potato too big for a two-ton truck to haul, cut slices from a loaf of bread higher than your head, and pour milk from a bottle as tall as a bungalow!

In the fifty-six years that the average American lives, recent statistics compiled by the U. S. Department of Commerce show, he consumes 106,400 pounds of food—enough to load to capacity several freight cars.

On other dishes at this colossal feast there would be a half-ton block of butter and a 224-pound slice of cheese. The sugar bowl would be six feet high and the salt shaker would weigh 800 pounds. There would be an egg 12,000 times the average size, an apple seven feet in diameter, an orange weighing 1,100 pounds. Around your table would be piled 1,120 tins of canned fruit, 124 cans of salmon, 600 tins of sardines, 336 pounds of dried fruit, 888 cartons of breakfast food, and, more surprising still, 280 pounds of rice. To top off your meal, you would find a 672-pound box of candy and nearly 6,000 sticks of chewing gum, not to mention fifty-six pounds of walnuts and 1,176 pounds of grapes.



You Can Run Radio in Car *without B BATTERIES*

Below, drawing of new dynamotor showing how it operates in running a radio set in an automobile. Current from lighting circuit rotates its armature. At right, a dynamotor for a car set is being installed beneath seat instead of the batteries formerly used

SIX-VOLT, heater type radio tubes, types 236, 237, and 238, solved the problem of a current supply for automobile radio sets. These durable, vibration-proof tubes can be connected directly to the regular six-volt lighting circuit of the car. The heaters are so designed that they do not suffer ill effects from the variation in voltage produced when the car's generator cuts in or out at varying car speeds.

Dry cell B batteries of standard type are commonly used to supply the necessary high voltage direct current required by the B circuits of automobile receivers. Now comes a new dynamotor unit that permits the elimination of these batteries.

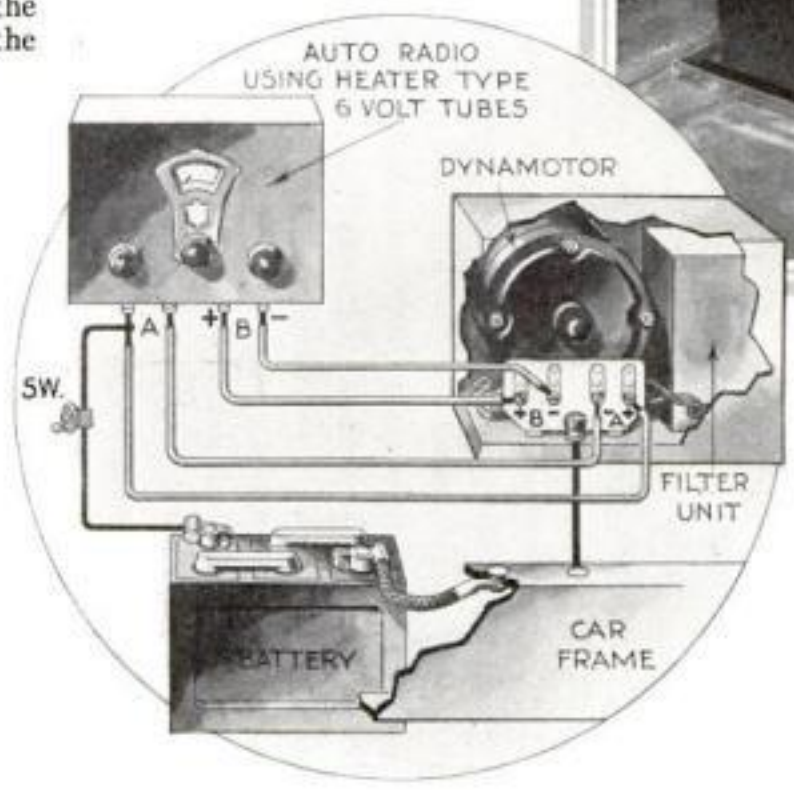
The illustration in the circle shows how these dynamotors operate and the picture at top of page shows one being installed under the seat of a car. The dynamotor itself looks like an ordinary small direct current motor. Current from the car's lighting circuit rotates the armature, which is of special design. It is wound with a separate set of coils of fine wire that are carefully insulated from the six-volt winding.

As the armature rotates because of the magnetic pull developed by the battery current, a much higher voltage is generated in the fine wire coils. The commutator at the other end of the armature delivers this high voltage to a filter unit like that used in the ordinary B eliminator. The filter gets rid of the ripple or pulsation produced by the commutator and allows only pure direct current to flow to the B circuits of the radio receiver.

The current drawn by the dynamotor from the car circuit is about the same as that used by a headlight bulb and it delivers forty milliamperes at 180 volts, enough to take care of the average automobile radio set.

The introduction of this new piece of radio apparatus offers new possibilities to the radio experimenter who lives on a farm where the only source of electric current is a thirty-two-volt farm lighting plant.

With any conventional five- or six-tube radio circuit, it would be practical to arrange the wiring to use the six-volt heater tubes in series connected directly to the thirty-two-volt supply, with a dynamotor to supply the high voltage B current. Of course, the dynamotor would have to be operated from only three cells of the farm lighting battery, or it could be operated directly on thirty-two-volt current if suitable resistances were used to maintain the voltage across the terminals at six volts.



For use on thirty-two-volt farm lighting circuits, the driving windings could be wound in quantity for thirty-two-volt current at only a slight increase in cost over the six-volt windings now supplied.

Testing Voltages

IT OFTEN becomes necessary to find out how much electrical voltage or pressure is being developed between two unmarked terminals.

You may, for example, have on hand a power transformer that was originally intended to be a component part of some factory built set. Of course the ideal way to find the voltages at the various terminals is to use a multi-range alternating current voltmeter. Lacking such equipment, you can identify the windings with the aid of a few electric light bulbs.

The average power transformer usually has a center-tapped high voltage winding which may develop from two to three hundred volts each side of the center tap. The outside terminals of the winding may therefore develop as much as 600 volts. The first job is to locate these three wires. But remember that 600 volts can give you quite a jolt.

Connect five or six fifteen-watt, 110-volt electric light bulbs in series with each other. Attach an insulated test prong to each end of the series. Next, after making sure that all secondary wires are standing apart from each other so that there will be no chance of a short circuit, connect the primary winding to the electric light circuit. Now carefully touch two wires at a time with the test prongs. When you hit the two wires attached to the ends of the high voltage winding, the bulbs will glow brightly. Touching one of these wires and the center tap lead will cause the bulbs to glow dimly (half voltage).

Once the high voltage leads are located, they should be marked and wrapped with insulating tape to avoid the danger of a shock while you are experimenting with the rest of the wires.

Follow the same procedure in identifying these windings, except that a two- or four-candlepower six-volt auto bulb should be substituted for the five 110-volt bulbs.

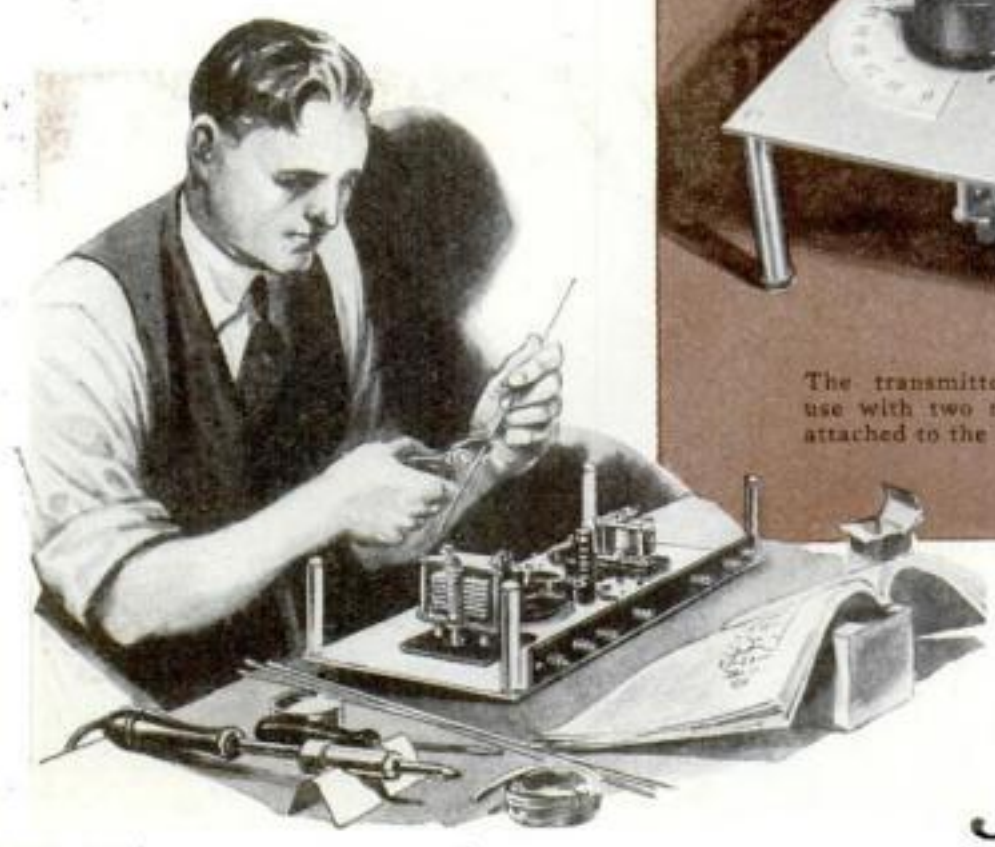
Auto Sets at Home

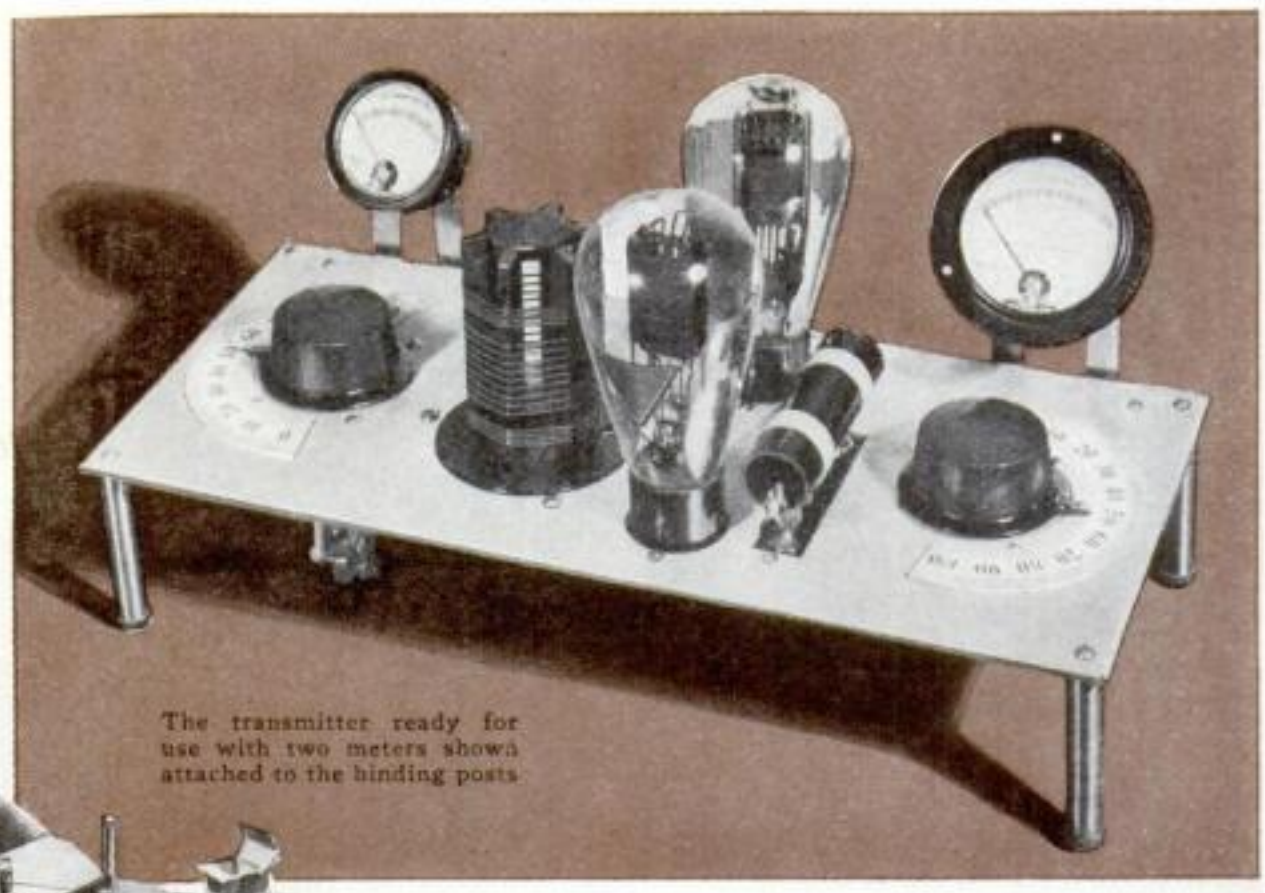
IF IT is desired to operate an automobile radio receiver or other set using the new six-volt heater type tubes 236, 237, and 238 at home, an alternating current filament heating transformer can be used if proper provision is made for balancing out the hum. If no transformer developing precisely the right voltage is available, you can use a seven-and-one-half-volt transformer or a toy transformer such as is sold for operating electric trains. If the latter is used, it should be set for a nominal seven or eight volts.

The excess voltage can be controlled by an ordinary battery rheostat. For a six-tube set, use a rheostat having a resistance of two or three ohms or two six-ohm rheostats connected in parallel.

For a three-tube set, such as the amateur short wave set detailed in POPULAR SCIENCE MONTHLY Blueprint No. 155, a single five- or six-ohm rheostat will do.

HERE *is a transmitter that will appeal to the beginner or expert. It is simple and inexpensive to construct and easy to operate efficiently*





The transmitter ready for use with two meters shown attached to the binding posts

JOHN CARR *tells*

How to Build

Your Amateur Transmitter

HERE is an amateur continuous wave radio transmitter that is simple to build, easy to adjust, and efficient in operation. It will appeal both to the beginner and the more advanced amateur. When properly installed and adjusted, it will meet the Government requirements for purity and sharpness of wave in the amateur bands, a point often overlooked in the designing of low power amateur transmitters.

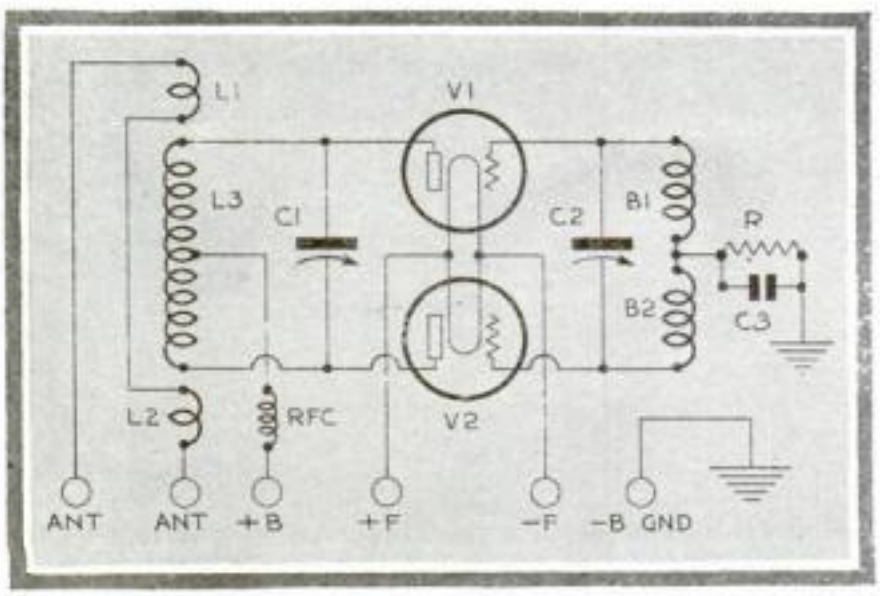
The circuit is the latest push-pull arrangement, using two power tubes. Its flexibility is remarkable. It will function perfectly with two type 171A tubes, a pair of 245's or a couple of 210's. You have, therefore, a choice of power output ranging from four to thirty watts. Changing the tubes in this way calls for a change in the power supply as well, but no change need be made in the unit itself, however.

The effective range of the transmitter depends on the output. Remarkable distances have been covered with only four watts applied to the antenna.

A complete amateur radio transmitter consists of an antenna system, a transmitter like the one described here, and a power supply unit. If 171A tubes are used, a five-volt filament heating transformer and any ordinary B eliminator capable of delivering forty milliamperes of current at 180 volts form a suitable power supply unit.

If 245 tubes are used, it is possible to obtain the necessary power supply from any standard broadcast receiver that uses two type 245 tubes. Extra switches can be installed in the broadcast set so that the current from the power pack of the receiver can be cut off from the regular circuit and delivered to the amateur transmitter. Obviously, the broadcast set cannot be used at the same time, because the receiver's power pack could not handle the double load.

When type 210 tubes are used, it is necessary to have a seven-and-one-half-volt filament heating transformer and a B supply unit capable of delivering 100 to 120 milliamperes at voltages ranging from 400 to 500.



Theoretical diagram of short wave transmitter described in this article. Note the simplicity of the push-pull circuit

No attempt will be made in this article to describe the antenna system for this transmitter. Several different arrangements are possible, depending on local conditions. Antennas for this set will be described in detail next month.

REMEMBER that you do not have to pass the Government amateur radio license examination before you build your transmitter. You can go ahead and build this set while you are studying for the examination. In fact, you will find that building the set will help you to acquire the knowledge necessary to get a passing mark.

How much will it cost to build the transmitter? That depends on a number of things. A factory built amateur receiver of this type, embodying this circuit, complete with the necessary plug-in coil units for the three amateur bands, can be bought for about twenty dollars.

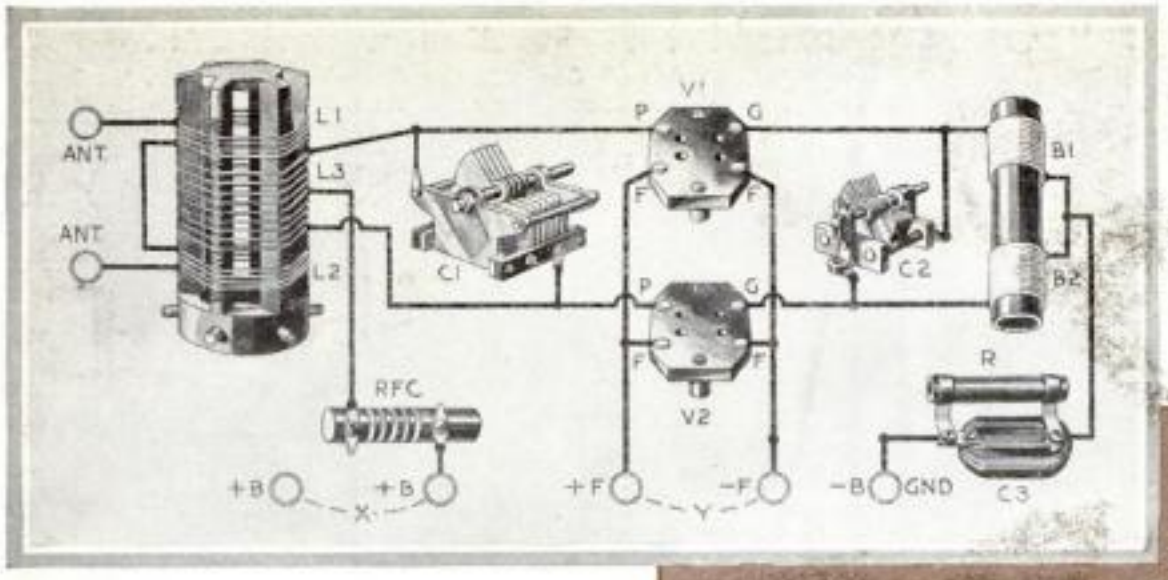
If you dispense with the plug-in coil arrangement and build the outfit for a single band with fixed coils, the cost will be less. However, the plug-in arrangement is better, as it permits you to make the most of the variations in carrying power of the different amateur bands in daylight and dark.

Here are the parts you will need if you wish to build the transmitter just as shown:

L—Plug-in type plate and antenna coupling coil unit (set of three).

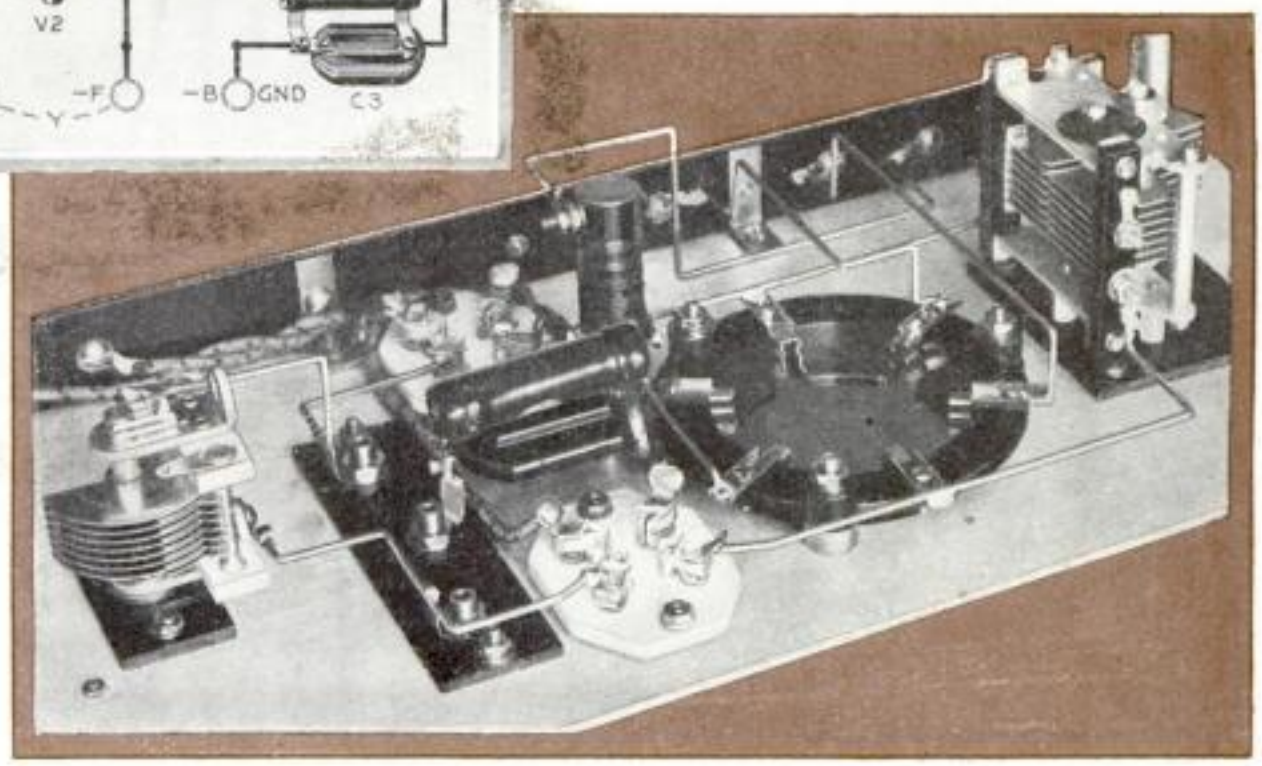
B—Plug-in type grid coil unit (set of three).

C1—Variable condenser. .00015 mfd. capacity.



BLUEPRINTS READY!

THIS modern amateur continuous wave transmitter unit is described in still greater detail in Blueprints Nos. 183 and 184. These give specifications for suitable transmitting antennas, power supply circuits for various tubes, and correct methods of connecting the transmitting key. *See page 100.*



Coil Specifications

Diameter of all *L* coils, 1 15/16 inches. Diameter of all *B* coils, 1 inch. All *L* coils wound with No. 18 wire, bare or insulated. All *B* coils wound with No. 22 double cotton covered wire. All *L1* and *L2* coils wound with four turns of wire, spaced wire diameter. Spacing between *L1* and *L3*, and *L2* and *L3*, ¼ inch in all cases.

FOR 20 -METER TRANSMISSION

L3, two turns each side of center tap, spaced ⅛ inch. *B1* and *B2* five turns each, close wound, 1½ inches apart.

FOR 40 -METER TRANSMISSION

L3, five turns each side of center tap, spaced ⅛ inch. *B1* and *B2* twelve turns each, close wound, 1¼ inches apart.

FOR 80 -METER TRANSMISSION

L3, ten turns each side of center tap, spaced wire diameter. *B1* and *B2* twenty-eight turns each, close wound, ½ inch apart.

• • •

C2—Variable condenser, .0001 mfd. capacity.

C3—Fixed condenser, .002 mfd. capacity.

R—Fixed resistance, 1,000 ohms.

RFC—Radio-frequency choke.

V1 and *V2*—Standard X-type sockets.

Plate and antenna coil socket.

Grid coil socket.

Aluminum panel, 7 by 15 inches.

Binding post panel, bakelite, 1 by 13¾ inches.

Bakelite mounting plate for condenser *C1*, 2¼ by 2¾ inches.

Bakelite mounting plate for condenser *C2*, 1 by 2 inches.

Brass or wooden legs fitted with rubber buttons, 2¾ inches long.

Dials, binding posts, bus wire, etc.

IT IS not necessary to use an aluminum mounting panel. Bakelite or thoroughly dry hardwood will do. If wood is used, give it two coats of shellac.

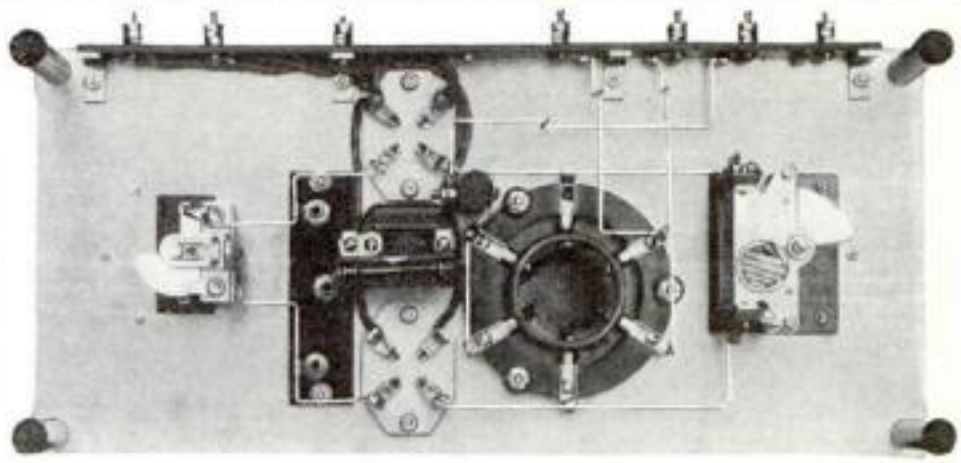
Note that there is no metallic connection between any of the parts or the wiring to the panel. The panel, however, is grounded and forms a shield over the condensers and therefore makes tuning easier. This is the only advantage, aside from appearance, of the aluminum panel.

For the benefit of those who wish to construct their own plug-in type tuning inductances, the specifications are tabulated above. If you do not care to go to the trouble of building the coil forms, it is possible to buy blank coil forms and the socket. The price for the unwound forms is less than for the finished coils.

The variable condensers should be high grade with fairly well spaced plates. It is not, however, necessary to use the special double-spaced types of transmitting condensers sold for higher powered outfits.

Good sockets are desirable. The transmitting tubes run much hotter than do similar tubes in receiving circuits, and the isolantite sockets shown are worth while.

Note that the view on the opposite page, of the finished transmitter ready for use, shows two meters attached by means of flat metal strips to two pairs of binding posts.



Picture wiring diagram at top of page corresponds with the theoretical circuit on opposite page. The bottom view and the close-up will help you with the wiring. Make sure coil socket connections check with picture diagram

THE picture wiring diagram indicates where these two meters are to be connected. The meter across the filament binding posts F and F, indicated by dotted lines and the letter Y, is a filament voltmeter. It assures you that the filaments of the tubes are operating at exactly the right voltage. This is desirable if the filaments are to be run from a storage battery. In that case an external rheostat should be connected in one lead from the battery so that you can regulate the voltage to the correct value.

If the filament circuit is to be operated by a small A. C. transformer, an A. C. meter can be used but is not really necessary.

The other meter, connected at X, should be a direct current milliammeter with a maximum reading of 150 milliamperes.

WHILE not absolutely essential, this meter will make tuning the set much easier. It also serves as an indicator that the tubes are working at proper efficiency. Its functions will be discussed in detail in a subsequent article on the operation of the transmitter. The two binding posts marked B plus are provided so that the meter may be used or not as desired. If used, it is connected between the binding posts, and the power supply wire is attached to the end binding post, so that current must flow through the meter to reach the tubes. If the meter is not used, the plus B supply wire is attached to the second post.

Before you start to do the wiring, it is well to understand how the transmitter works. It will help you to appreciate the need for care at certain points in the wiring.

The arrangement is a modern push-pull version of the tuned-grid, tuned-plate circuit much in vogue when variometers instead of condensers were used in receiving sets. Instead of placing the grid and plate coils so close that regeneration and the consequent oscillation is obtained by magnetic coupling, *(Continued on page 104)*

"Climb down," Gus told the disturbed car owner, "and let me drive it so I can see what this noise sounds like"

GUS explains

Mystery of Vibration in Car

By MARTIN BUNN

"STOP the car, Clem," Mrs. Ferrers commanded. "I can't stand that awful drumming sound another moment. My head aches like fury. It's driving me crazy. Can't you do something about it?"

Clem Ferrers smiled placatingly. "Sure, Aggie, we'll stop and I'll see what I can do. It didn't seem so bad to me."

"It wouldn't!" his wife snapped. "I declare, Clem, you'd never notice anything wrong so long as the wheels keep turning around."

With that she sprang out, plumped herself down on a near-by rock, and rested her head in her hand, a picture of woe.

"Good thing I'm not so gosh-blinked fussy," Clem murmured to himself as he clawed the tool kit out from under the rear seat and hesitatingly thumbed over the various articles in it. Finally his eyes lighted up as his fingers closed over the handle of a huge monkey wrench.

"Maybe a couple swipes with this'll bend it so it won't rattle so," he muttered as he climbed up on the fender and began to inspect the top.

At this particular point in the proceedings, an auto service car labeled "Model Garage" hove into sight with the huge hands of Gus Wilson clasped firmly around the steering wheel. Perched beside the veteran auto mechanic was his partner Joe Clark.

"What do you reckon he's fixing to do up there with that big wrench?" Joe questioned as Gus applied the brakes.

"That's just what I want to know," Gus said as he climbed out and walked over to Ferrers' car.

"What's gone wrong, mister?" he asked.

"The madam, there, she says something in the roof is humming so it gave her a headache." Clem explained. "I thought maybe if I gave it a couple of socks here and there, whatever is loose might get stuck so it couldn't wiggle any more. Got any good ideas?"

"Sure," said Gus. "Climb down and let me drive your car so I can see what the noise sounds like."

Gus took the wheel, with Ferrers beside him, and drove off.

"There's nothing the matter with the top," Gus reported when they got back. "Trouble is, some of the body bolts have come loose. At certain speeds you get a vibration in the body that seems to come from the top. I'll tighten up the bolts."

"Beats me how the noise could sound like it came from the top when those bolts underneath were doing it," Ferrers puzzled, as he bent down to watch the work.

"Simple enough," Gus told him. "All noise comes from vibration. And vibrations scoot around in metal or wood till they reach a place where there's a broad, flat surface that isn't fastened all over. Then off they go into the air. Your ear tells you where the noise is coming from, but not how it got there."

"THAT was a funny case," observed Joe as the two garagemen continued on their way home. "There's a lot about this vibration business I don't savvy at all. For instance, I can understand how mounting an engine in the chassis with rubber at every point ought to cut down the vibration, but what's the difference between just ordinary rubber mounting and this 'floating power' they talk about? Does 'floating power' mean anything at all?"

"Did you ever hit a baseball too near the end of the bat, or maybe too near your fingers?" Gus countered. "Stung like a flock of bees, didn't it? When you hit the ball with just the proper spot on the bat, you didn't feel anything except the club stopping in the air, eh? Well, floating power is like that. It's all in the location of the engine supports.

"Suppose," Gus continued, "you could hang an engine up in the air without any supports and start it going, what would happen? It would vibrate a bit—no engine is perfect that way—but if you looked over the engine, you'd find at least two spots that didn't seem to move at all. They're like the spot on the baseball bat and the place where your hands hold it. You could touch one of those spots on the engine and you wouldn't feel any vibration to speak of, showing that the whole engine was wobbling back and forth with that point as one of the centers.

"Floating power means holding the engine in the frame by those points where there's no vibration—after you've found where they are. Of course, you can't hang an auto motor in the frame with only two supports. Extra rubber-mounted brackets are put in to steady the engine a bit and to keep it from *(Continued on page 107)*

GUS says:

The fellow who takes a real interest in his car often gets to be a specialist. That's bad business. What's the use of spending all your time trying to get the carburetor adjustment perfect, if the ignition system isn't up to scratch? Why clean spark plugs till you have the corners worn off when the shock absorbers really need attention? It's a lot more sensible to have everything about the car somewhere near right.

How to Build Our New *Sportboat*

. . . A Trim, Smart Looking Runabout with the Conveniences of a Cruiser

By
WILLIAM JACKSON

The "sportboat" ready for her speed tests with Mr. Jackson at the wheel. He tried out the hull under all conditions and even made hairpin turns at full speed. *At right:* The boat with the cruiser top removed

FINE performance, smart appearance, and general utility are combined in the new POPULAR SCIENCE MONTHLY "sportboat." It has the style, speed, and convenience of a runabout together with the comforts and roominess of a small, light cruiser.

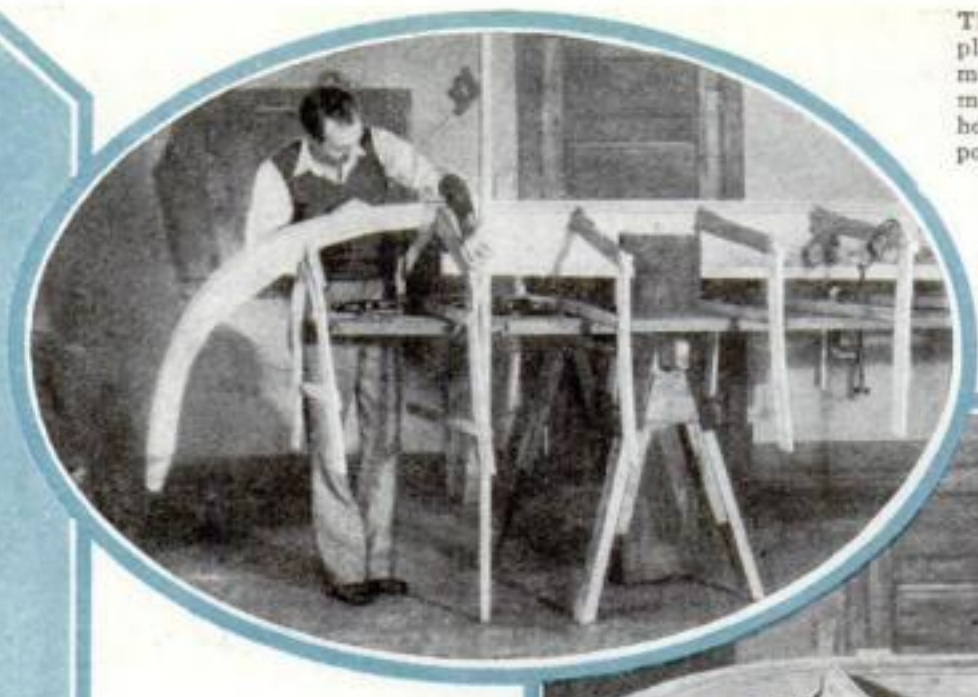
The overall length of the hull is 15 ft. 6 in.; the extreme beam, 5 ft. 3½ in.; and the weight without the motor, 600 lb. The "sportboat" may be used with D, E, and F outboard motors or small inboards up to 60 H.P. Under the urge of a four-cylinder outboard, the boat may be expected to average about 25 M.P.H. The cost of materials, based on what I paid, will vary from $100 to $125 or slightly more, depending on the locality and the kind of lumber used.

After home waters have been thoroughly explored, the boat can be provisioned—there is ample stowage space under the decks and seats—and cruises may be made anywhere on our thousands of miles of beautiful inland and coastal waterways. When the "hook" is dropped overboard at night, the bunks can be made ready merely by lowering the collapsible seats. If cruising is out of the question, the "sportboat" can be used as a runabout or for hunting and fishing. On fine days, if thought desirable, the top may be removed.

The design is of an advanced type that will be seen more and more frequently in the next year or two. The freeboard is somewhat higher than many present-day hulls, and the chines are not pinched in at the transom. There is no extensive tumble home at the after sheer; instead, the sides are of molded construction. All this insures greater safety, better maneuverability, and sportier appearance. At the same time the hull is not difficult to construct.

The boat has been tested under all conceivable conditions on smooth water and on extremely rough water, with from one to five passengers aboard. I have even run the boat up to a mark with the motor wide open and made hairpin turns (although I do not recommend this); and,

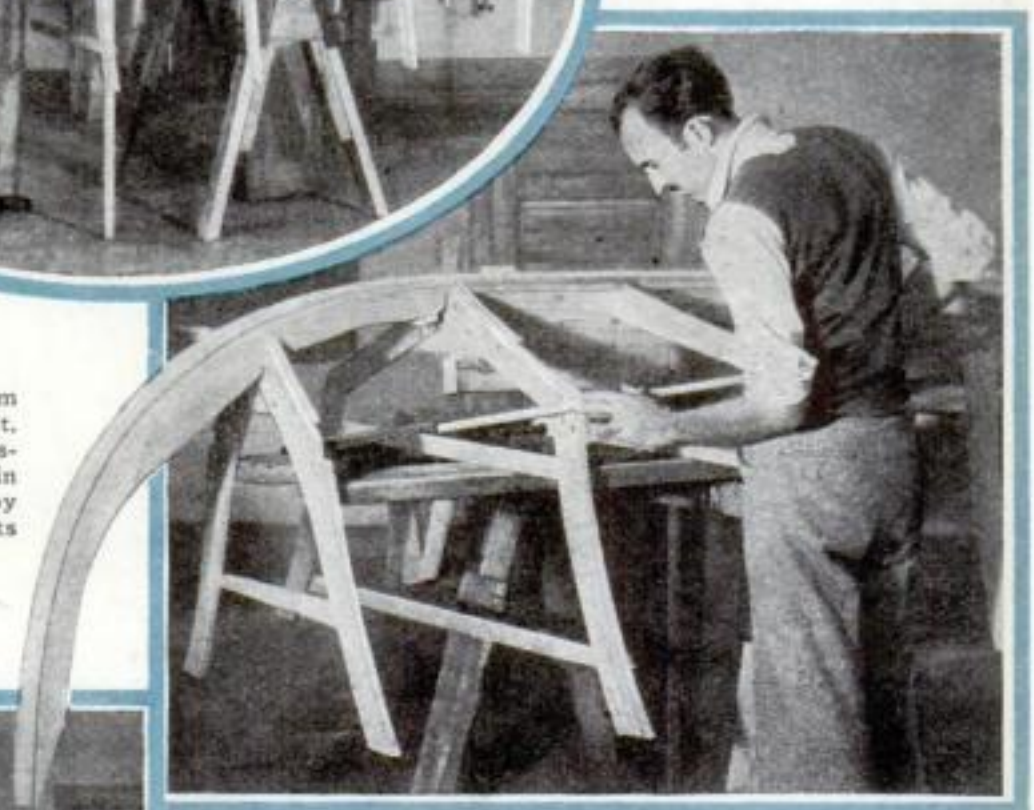
The frame parts, when cut out, are assembled on the paper pattern and riveted or bolted together

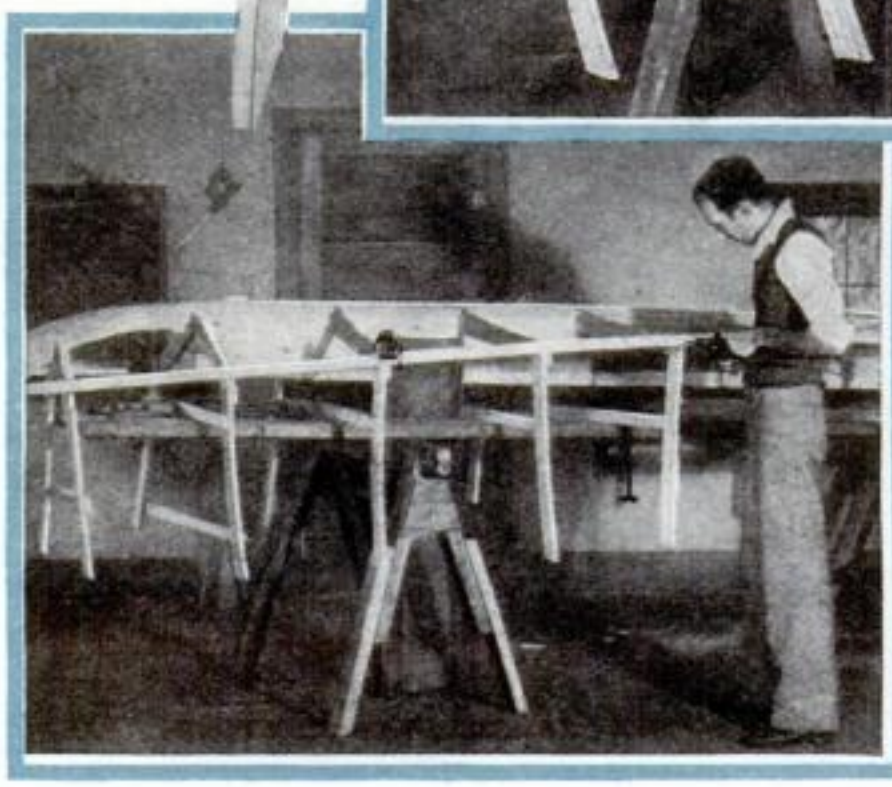


The form, which is merely a heavy plank with a series of notches, is mounted above two sawhorses. Two more planks are laid flat on the horses and on these rest the temporary strips which brace the frames

It is essential to be sure the chine notches are correctly beveled, as indicated below. Then the frames are squared and the stem lined up

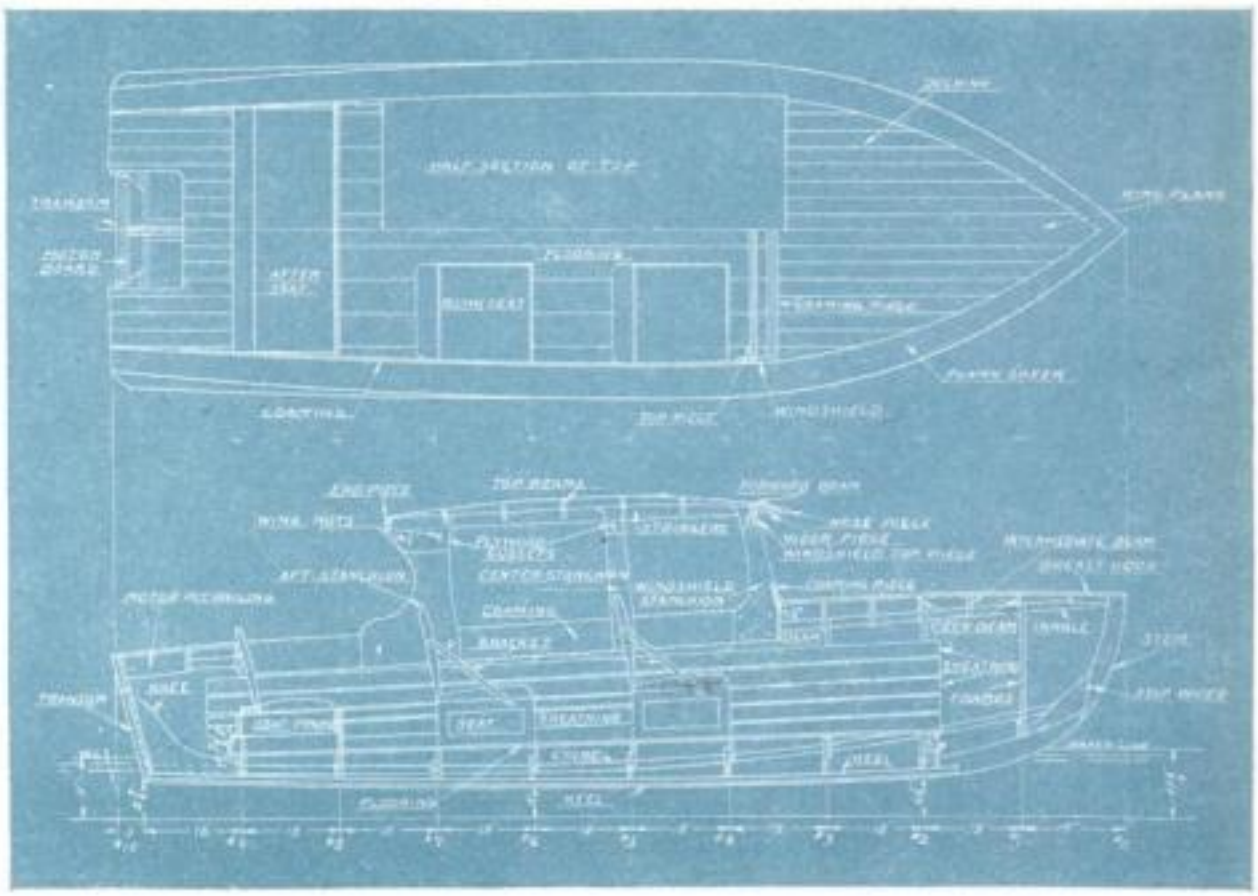
The complete stem appears at the left. Its parts are fastened with casein glue and four 6 by ¼ in. carriage bolts





The next step is to fasten the chines to each frame with one 2½-in. No. 10. F. H. screw. These screws must be well countersunk, especially forward

The general assembly drawings are reproduced below. Much larger drawings, together with several other assemblies and a complete set of carefully dimensioned details, appear on Blueprints 175, 176, and 177



remarkable as it may seem, a speed of 33 M.P.H. has been attained with one of the smaller "quad" motors.

Complete drawings, both assembly and detail, are given on POPULAR SCIENCE MONTHLY Blueprints Nos. 175, 176, and 177, which will be sent to any reader for 75 cents (a coupon for ordering will be found on page 100). To make the work still easier, the writer will prepare full size patterns from his own master templates for those who desire them. These should be ordered from the Blueprint Service Department. The price of blueprints and patterns together is $2.25.

On one of the blueprints are plans showing how to install an inboard motor amidships, if desired. It is also practical to place a small motor under a short deck aft and use it in combination with one of the new stern drives. The method of installing a stern drive in this boat is the same as that for the three-in-one hull described in previous articles; it is shown on Blueprint No. 150, which can be obtained for 25 cents.

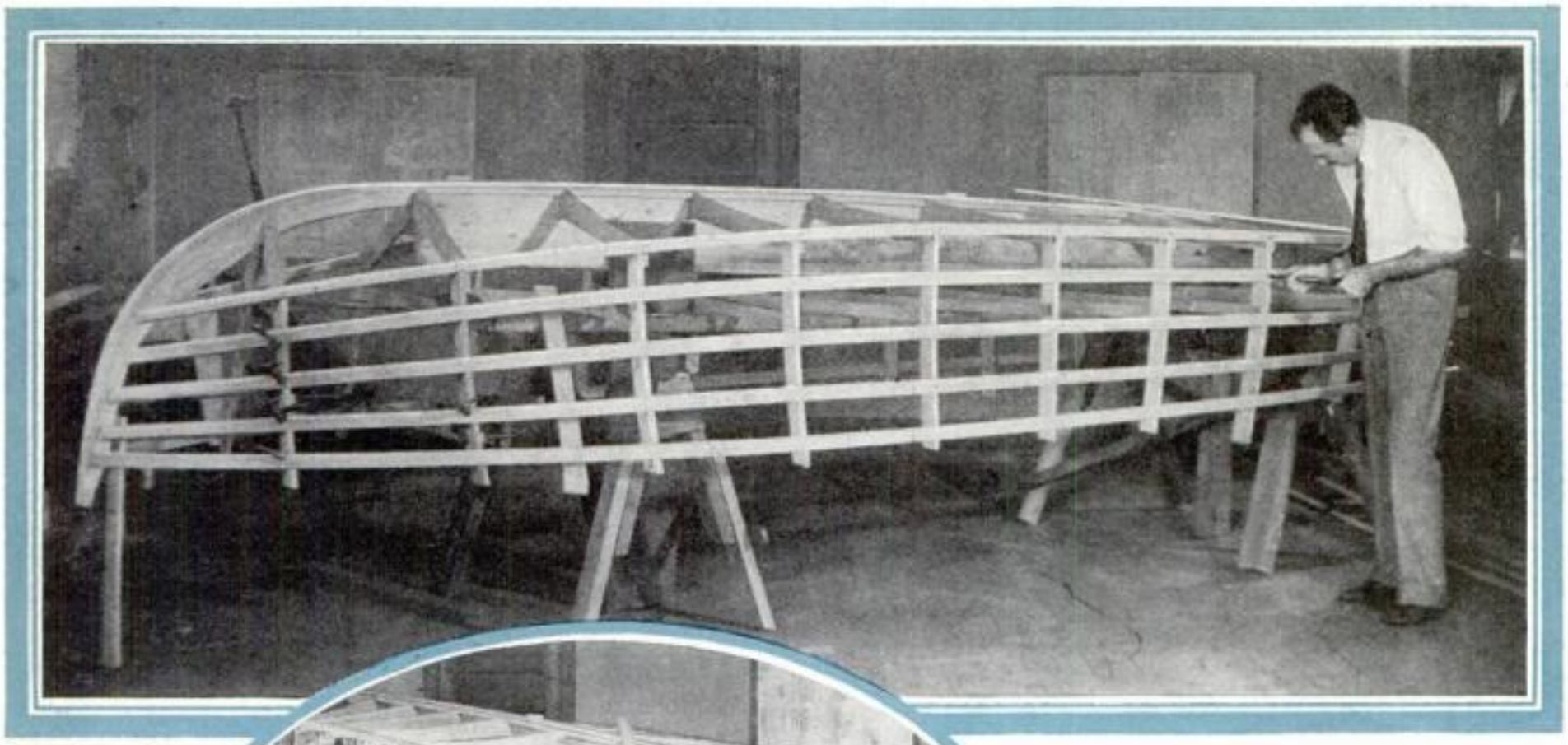
A word about the lumber: If at all possible, use one of the varieties of mahogany for the planking and oak for the frames. Mahogany costs a little more than ordinary lumber, but its ability to hold fastenings, resist long water soaking, and stand up under all conditions is unsurpassed. If the mahogany and other expensive woods are purchased in 1-in. rough stock and the various sizes are milled out at a local mill, a saving can be effected. Brass and copper fastenings are best.

An electric drill and a shop equipped with small home woodworking machines will expedite matters, but lacking these an excellent job can be turned out by hand. About eighteen 5-in. C-clamps will be needed in addition to carpenter's tools.

As the work progresses, make certain that the hull is true and accurate in shape.

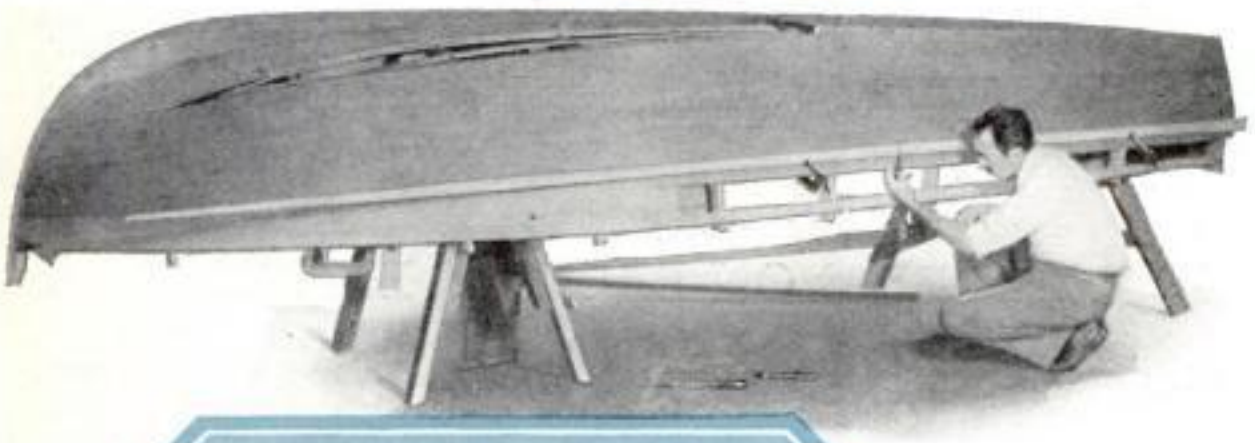
A notched plank form is first prepared as shown on the blueprints and mounted above two sawhorses, then braced well. Fasten two planks to the top of the horses as shown in the photographs. The cross strips holding the frames in shape rest upon these and hold the frames level.

Next lay out the various frames and



Fastening the battens for the side planking. These divide the space between the inwale and the chine into four equal parts

In the oval is another view of the framework. Note in particular how it is braced to prevent twisting



Mr. Jackson demonstrates the way to use what is called a "spiling batten"—the narrow strip clamped temporarily to the hull. He is transferring measurements to the batten with dividers

When the sides have been planked, it is necessary to trim and fair the bottom and notch battens into the frames as shown at the left. The more or less irregular line at the edge of the plank is marine glue with strips of cloth laid on it to insure an absolutely water-tight joint

stem full size on building paper (unless you have obtained a set of the writer's patterns). With the full size patterns made, lay the patterns on the frame material and prick the outline through the paper onto the lumber. The component parts of the frame are then laid upon the patterns so as to conform to the outline, and fastened with three 1¼-in. copper rivets or three ¼ by 1½ in. carriage bolts at each joint. Each floor on frames No. 1 and 2 will require six 1¼-in. rivets. Let the side members of the frames extend over the pattern marking an inch or so. The top edge is sawn off afterward.

The side and the bottom members of frames No. 10 are butted together and joined with a ⅝-in. three-cornered block as shown on the blueprints. Coat these blocks with high-grade waterproof casein glue and fasten one to each joint with six 1¼-in. copper rivets.

Nail strips of wood across each frame to prevent its twisting out of shape. Notch the frames for the keel, and clamp the frames temporarily to the keel. Lay a light batten along the side members of the frames. Mark on the edges of the side members the correct bevels. Remove from the keel and bevel the sides correctly. The notches for the chines are now sawed out of the frames.

The full size paper pattern of the stem is next laid down upon the stem material and the outline pricked through. Let about 2 in. of the stem head project above its proper height. With the stem sawed to shape, lay the pieces down on the pattern to conform to the outline. Coat the stem knee with casein glue and fasten the stem together with four 6 by ¼ in. carriage bolts. Hack saw the sides of the bolt heads off so as to leave a head about ¼ in. wide. Countersink this head, and plug with wood plugs or a plastic wood composition.

The bevels, rabbet, and bearding lines are next marked upon the stem. These are taken from the stem section drawings. Connect these marks with continuous lines, and bevel properly. These bevels vary with the shape of the boat. The rabbet is cut next. A small template made as shown on Blueprint No. 176 will give the proper depth *(Continued on page 101)*

DECORATIVE COPY OF EGYPTIAN URN TURNED FROM WOOD

This unusual wooden urn is intended primarily for holding flowers, but it makes an attractive ornament without them

ANYONE possessing a small lathe can turn from wood an authentic copy of an ancient Egyptian urn. When used either as an ornament or as a holder for flowers, it harmonizes with any decorative scheme.

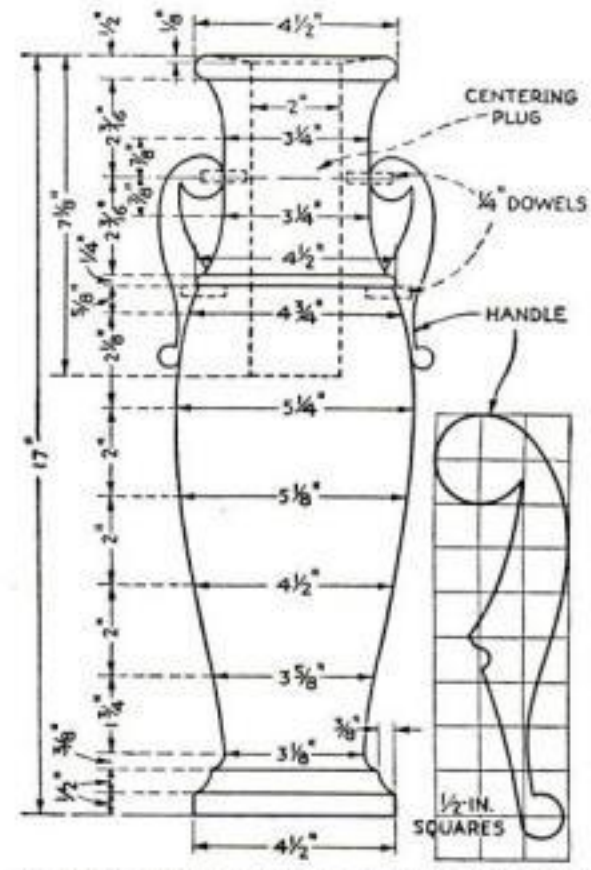
Mahogany, walnut, and cherry all work up well, but any wood with an attractive figure can be used. In some cases it may be possible to obtain the material in a solid piece, otherwise it will be necessary to glue up several dressed pieces to make a piece 5¼ in. square by 17 in. long.

Bore a hole in the center of the stock to receive the flower receptacle. In the urn shown, this hole was made 2 in. in diameter and 7 in. deep. The receptacle was cut from a piece of No. 20 gage sheet copper, and the side and bottom seams were soldered to form a water-tight cylinder. In case it is desired to use a large test tube or a straight sided bottle for the receptacle, bore the hole to suit, using an auger bit with a coarse-thread spur for end-wood boring.

From a piece of scrap wood, turn down a plug about 3 in. long to fit this hole, though not too tightly or it may split the stock. Insert the plug so that the dead-center hole can be used in turning the urn.

After the stock is turned to the dimensions shown, saw out the two handles from ½-in. material and carefully dress them down to fit the contour of the urn at opposite points. These handles are attached with ¼-in. dowels, which may be inserted to make a "blind" joint as shown or allowed to extend through the handles.

A soft, lustrous, well-rubbed finish should be applied in keeping with the antique design.—L. C. PELTIER.



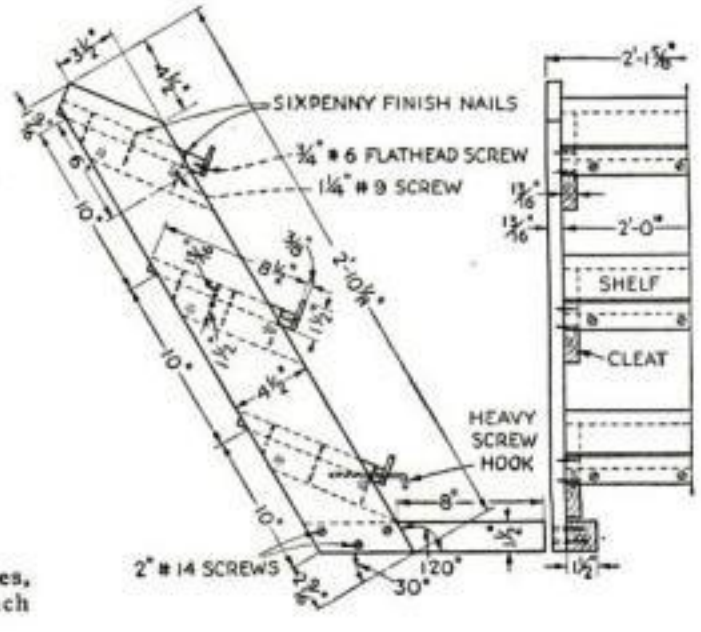
If these dimensions are followed, the urn will be an exact copy of an authentic antique

LADDERLIKE TOOL RACK FITS ON BACK OF BENCH

BY FAR the handiest tool rack the writer has ever used is that pictured in the accompanying photograph. Supported by the bench top, it affords 6 lineal feet of inclined shelves within convenient reach of the workman at the vise—sufficient to hold all the small tools anyone ordinarily uses in the general round of work.

The rack, which consists of three slanting shelves, projects above the bench and is within handy reach

The tools are grouped according to their function—cutting, sawing, rasping, grinding, screw driving, scribing, and hammering. Black silhouettes on the shelves, together with nails driven to separate the tools, make it easy to locate the proper place for each. One can train himself to lay his scratch awl or screw driver in the rack after every use of it, with the result that work on the bench is more easily handled, and no time is wasted in looking for small tools hidden behind larger ones or under shavings. Tools cannot be pushed into clip holders or holes so quickly.



The dimensions given on the drawing are merely suggestive. The two sides are of 1 by 5 in. stock, cut to incline backward about 120 deg. with the bench top. Three shelf cleats are screwed to the inner sides, and 8½ in. wide shelves are nailed to the cleats. Strips ⅜ by 1½ in. are screwed to the front edges of the shelves to prevent the tools from sliding off.

Screw a 1½ by 1½ in. cleat to each sidepiece at such a level that it will fit under the bench top. Two or three heavy screw hooks are then inserted in the front edge of the lower shelf to clasp the back of the bench. In this way the rack is held firmly, although it can be pushed from one end of the bench to the other. If the solid top extends to the back of the bench, slots may be cut at regular intervals into which the hooks can be turned, or the rack may be screwed solidly to the back of the bench.—EDWIN M. LOVE.

Unusual Child's Dresser Built to Look Like a Doll House

THIS unique and colorful piece of nursery furniture resembles a doll house but is actually a dresser. It even has a mirror to reflect a clean little face and well-brushed hair.

Smooth ¾ in. thick white pine or other soft wood is used for practically all the construction except the doors, which are of 5-ply veneer, and the back, which may be any thin material—wood, wall board, pressed wood composition, or plywood.

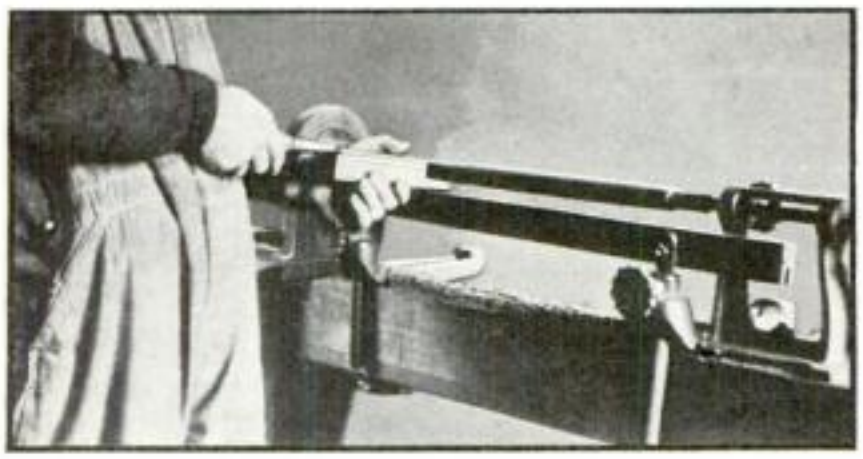
The sidepieces are each 10 by 36 in., and the width of the main framework is 23½ in. The top is 11 by 25½ in. so that it overhangs the ends and front of the framework slightly. The doors are 11 by 16 in., the top drawer is 8 by 9 by 22 in., and the bottom drawer 5 by 9 by 22 in. The compartment behind the doors is divided into four parts to hold toys and to serve as "rooms" when the dresser is used as a doll house. The base is a strip 4 in. wide. The miniature steps are cut from a block ¾ by 2 by 10 in. and nailed to the base.

The mirror, if purchased in a rectangular frame, may be removed and cut angularly at the top as shown to give the appearance of a peaked roof. In this case a mirror 13 by 17 in. was used, and two sidepieces and a tiny chimney were added to complete the "roof." Four butterfly hinges for the doors, five small glass knobs, and two door catches are the hardware required.

The painting should be done before the doors are hung. Use a good grade of ivory enamel for the entire body color. Paint a door about 4¾ by 10 in. above the entrance steps as shown. Make the windows about 4¼ by 5½ in., and the shutters or blinds 1¼ by 7¼ in. For these parts use light red, yellow, ivory, and black, or other brilliant colors, and dull blue for the blinds. Paint the base and the roof light red with ivory lines to imitate the mortar between the "bricks" and to outline the "shingles."—KATHLEEN EAMES LITTLE.

Whether this dresser is used for clothes or toys, children take real pride in keeping it in order. It does more than any number of orders to "put those things right away"

HOMEMADE TOOL FOR TURNING TENONS



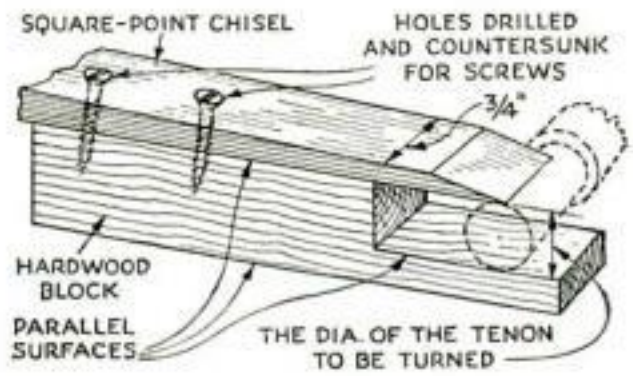
After the tenon has been turned in the usual way until about ⅛ in. oversize, the tenoning tool is applied as shown at the left. It does away with any need to use calipers

As indicated in the drawing below, the tool is a square-point chisel with a block screwed to it to act as a gage for finishing the tenon accurately

ANY amateur wood turner who has calipered tenons to size on a lathe knows how easy it is to get a tenon a little too small or too large, with the result that the joints are difficult to assemble properly. The accompanying illustrations show a tool that will not only insure correctly sized tenons but will do it in a fraction of the time needed to caliper them.

It is simply a square-point turning chisel about ¾ in. wide fastened to a hardwood or metal block with two screws. Two holes are drilled and countersunk in the chisel, and a corner is cut off the block as shown. The only dimension that needs be exact is the one which represents the diameter of the tenon to be turned. In screwing the chisel to the block, take care to keep the surfaces of the block parallel to the bottom of the chisel.

The tenon is first turned with ordinary turning tools about ⅛ in. oversize. The tenoner guide lip is then placed under the



tenon, and the tool pushed across the tenon till the chisel stops cutting. It is essential, of course, to take pains to keep the guide lip tightly against the underpart of the tenon.

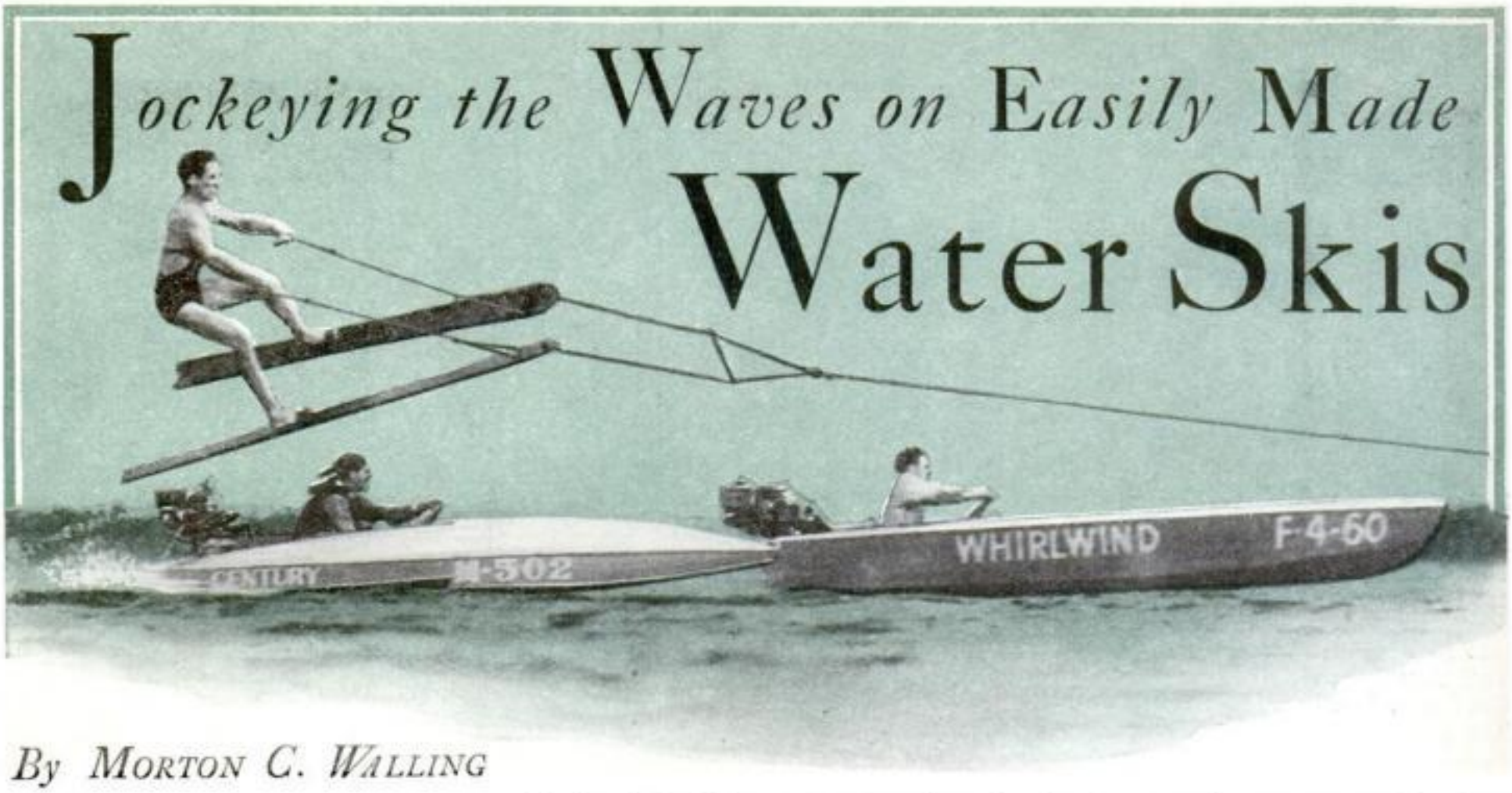
If you find the tenon too tight, after your first trial, file or dress a little off the top of the block; if too loose, file a trifle off the top of guide lip, or place a paper shim between the guiding block and the chisel.—R. C. RANDLE.

RUBBER TACK IMPROVES PUTTY KNIFE HANDLE

THE handle of a putty knife is often used to tap panes of glass which are being fitted into a sash or which have to be removed for some reason, but there is always considerable danger that the glass will be cracked or broken, especially if it is a tight fit in the rabbet. If a rubber-headed tack is driven into the end of the putty knife handle, the glass can be tapped smartly enough to move even a badly stuck pane without breaking or cracking it.—FRANK BENTLEY.

Glass may be safely tapped into place with a putty knife that has a rubber-headed tack driven into the handle end

Jockeying the Waves on Easily Made Water Skis



By MORTON C. WALLING

UNTIL you've returned spray-drenched from a speedy ride on a pair of easily constructed water skis, you've missed one of the most thrilling of water sports. Water skiing offers all the speed, excitement, and white water of aquaplaning with plenty of thrills and spills to spare. If you can swim, you can water-ski. In fact, experienced aquaplaners prefer the two skis to the usual single board, claiming that they are easier to control and safer for the beginner since they can be towed at speeds as low as 5 M. P. H.

Water skis, or aquaskis as they are sometimes called, are made in various sizes—5, 6, 7, and 8 ft. long. For the adult beginner, the 8-ft. skis are recommended since they offer more surface to the water and can be towed slowly.

Kiln-dried mahogany between ⅝ and ¾ in. in thickness should be used as stock for the skis. One has but to consider the use to which these skis are put to realize the importance of using high-grade lumber. Poor stock will soon warp out of shape and be useless.

First cut the lumber to size (length and width), round off the forward ends to a 4-in. radius, and cut the 6 in. diameter semicircles in the tails. The sharp, square top edges, excepting at the tail, should be rounded off or chamfered.

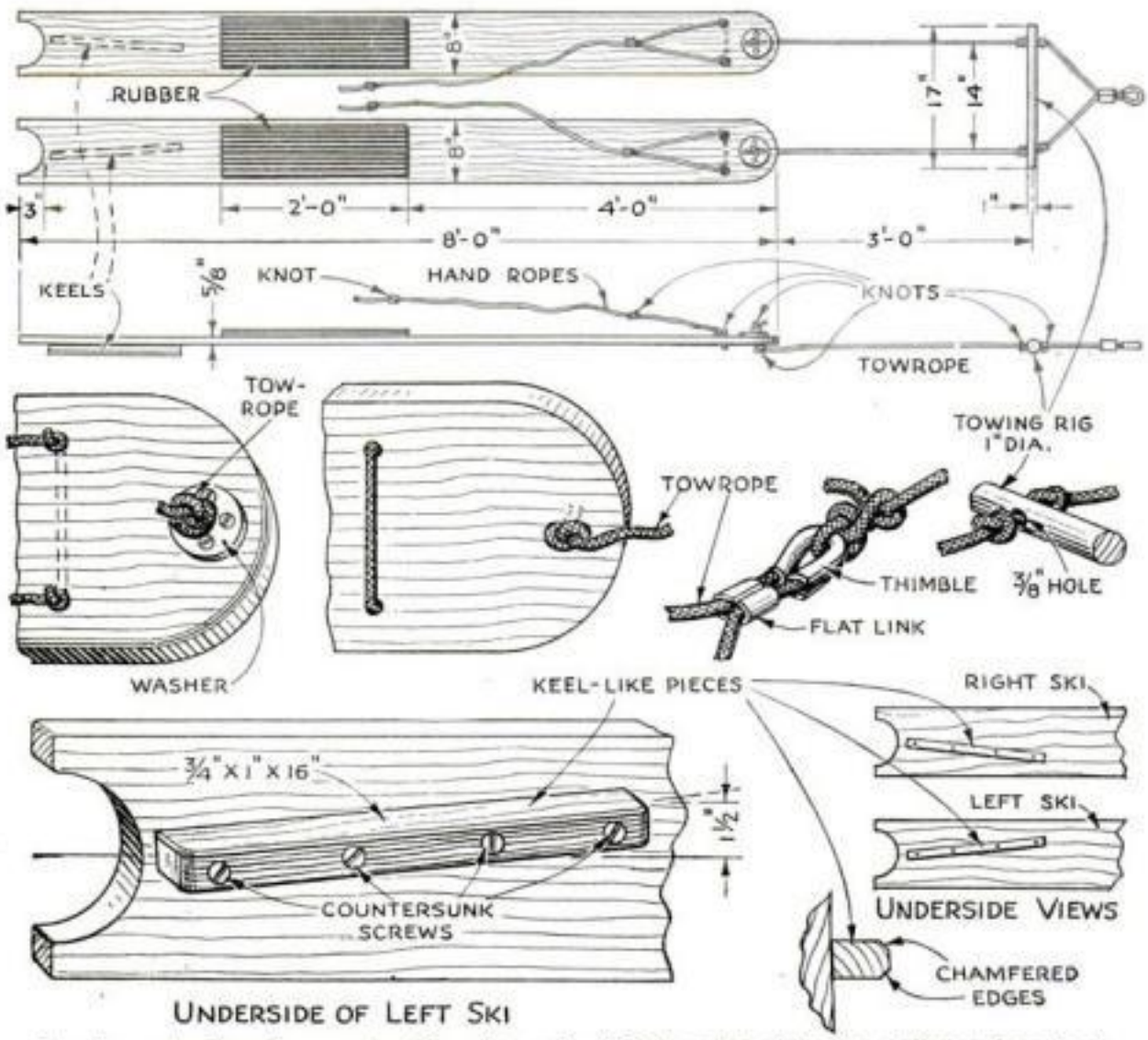
On the bottom of each ski, at the tail, is a small keel-like piece ¾ by 1 by 16 in. These are fastened at a slight angle as indicated (top ends 1½ in. off the center) and prevent the skis from riding apart and throwing the rider. Four brass screws, countersunk, are used to hold each keel in place.

At the forward end of each ski are three holes—one, on the center line, for the towing rig and two others, spaced 5 in. apart and placed 8 in. from the tip, for the hand rope. The towrope hole should be protected at the top with a washer, drilled and countersunk for four brass screws. This will prevent the rope from chafing the wood.

The towing rig, designed to hold the skis the desired distance apart, consists of a 17-in. length of 1 in. diameter stock—an old rake or hoe handle will serve. This is drilled 1½ in. from each end to receive the tow rig rope, which is a continuous length of ⅜-in. sash cord. Knot the sash cord each side of each ski and the spreader as shown in the drawings. A figure-eight knot should be used at the top side of the towrope hole. According to the speed at which the skis are towed, it may be necessary to alter the distance between the spreader and skis. This can be done by loosening the knots and slipping the spreader one way or the other.

An ordinary loop knot can be used to attach the rig to the main towing rope. If a more workmanlike job is desired, the loop can be made by wrapping the sash cord around a metal rope thimble, fastening it in place with a flat link. Thimbles and links can be obtained from any marine hardware dealer or large hardware store.

The hand ropes are 10-ft. lengths of sash cord threaded through the hand rope holes in the skis and knotted above each hole to prevent them from shifting. The



Drawings showing the construction of a pair of 8-ft. water skis. An ordinary loop knot can be used instead of the metal thimble in attaching the main towrope to the towing rig

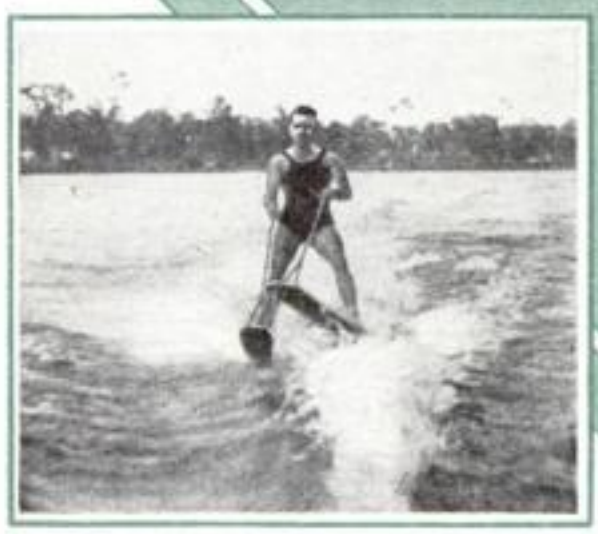
Although most beginners and even those more experienced are quite satisfied with the accomplishment of being able to stand erect on water skis while being towed over a zigzag course by a motor boat, there are experts who not only stunt at high speed but take to jumps just as a snow skier. In the photo at the top of the preceding page a famous dare-devil aquaplaner is shown just after a breath-taking jump in a race with speed boats.

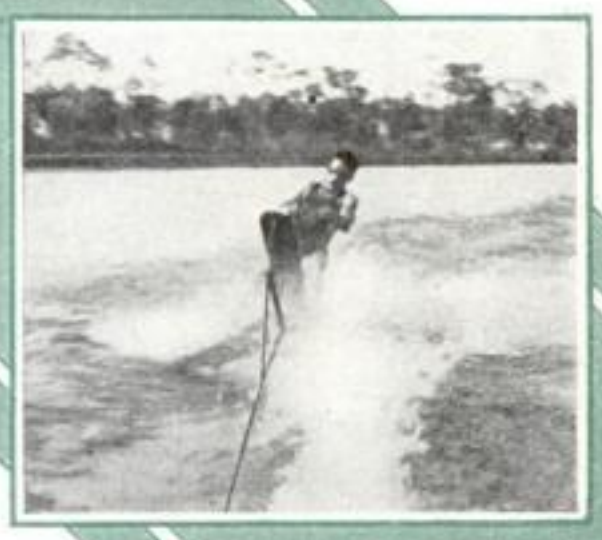
Let's follow the antics of the water jockey shown in the photos on this page. Directly at the left, he is shown standing on the starting platform waiting to be towed into the water. Reading to the left and then down and to the right, we see him just after the start, skimming along the surface of the water. Simple, isn't it? He thought so, too, until the pilot of the speed boat took several turns at increased speed. It looks as if he's having a bit of trouble. Off he goes! But it's only a short swim to shore, and although slightly dampened, his ardor is undiminished.

upper ends of the hand ropes should be supplied with a series of small knots spaced 4 or 5 in. apart to serve as handgrips.

Before finishing the skis, make sure that all surfaces and edges are smooth. Then give them a coat of stain, rubbing it down thoroughly, and finish with two coats of high-grade spar varnish and several applications of wax.

In towing the skis, arrange the length of the main towrope so the skis ride just back of the crest of one of the waves in the wake of the boat. Do not make the towrope too short. The skis can be mounted in two ways—while they are being towed slowly or from a low platform as shown in one of the photographs on this page. Beginners should not attempt the take off from a platform until they have thoroughly mastered the use of the skis. For platform take-offs, the front ends of the keel pieces should be cut back in a bevel so that they will not catch.





Water skiing offers all the thrills and speed of aquaplaning with plenty of spills to spare

HOLDER KEEPS ELECTRIC SOLDERING IRON TINNED

WHEN an electric soldering iron is continually heated and used for long periods, the copper tip requires frequent dressing with a file. To remedy this, a holder may be made that allows the copper point to be kept immersed in a small pool of molten solder. Each time the soldering iron is used, it comes out with a thin film of solder over the working surface and therefore is always clean, smooth, and properly tinned.

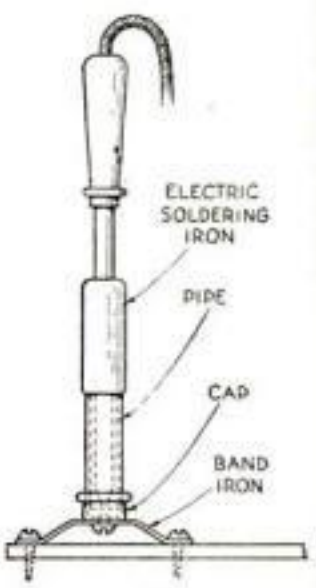
When not in use, the point of the soldering iron rests in a small pool of molten solder

The holder is a short length of wrought iron pipe about 1 in. in diameter and 3 in. long, having a standard pipe cap screwed on the lower end. This cap is drilled to receive a small machine screw so that it may be fastened to a bracket formed of light band iron as shown.

Where this arrangement is used by pieceworkers in a factory, the bracket may be formed in such a way that it can be fastened to the leg of the workbench within easy reach of the worker without moving from his seat.

Short pieces of solder are dropped into the container; then the soldering iron is put in with the electric current turned on. When the iron heats, the solder is melted and the copper tip stands in a bath of solder. After each joint is soldered, the iron is returned to the holder. The current may be left on continually as the material surrounding the soldering iron has sufficient radiating surface to prevent overheating. If the soldering iron is left in with the current off, it will become "frozen" in place, but turning on the current will quickly loosen or "thaw" it out again. Fresh solder can be dropped in from time to time to replenish the "tinning pool." Since dirt may get into the holder from the outside, it is also advisable to pour out the molten metal every so often and put in new.

—F. S. CULVER.



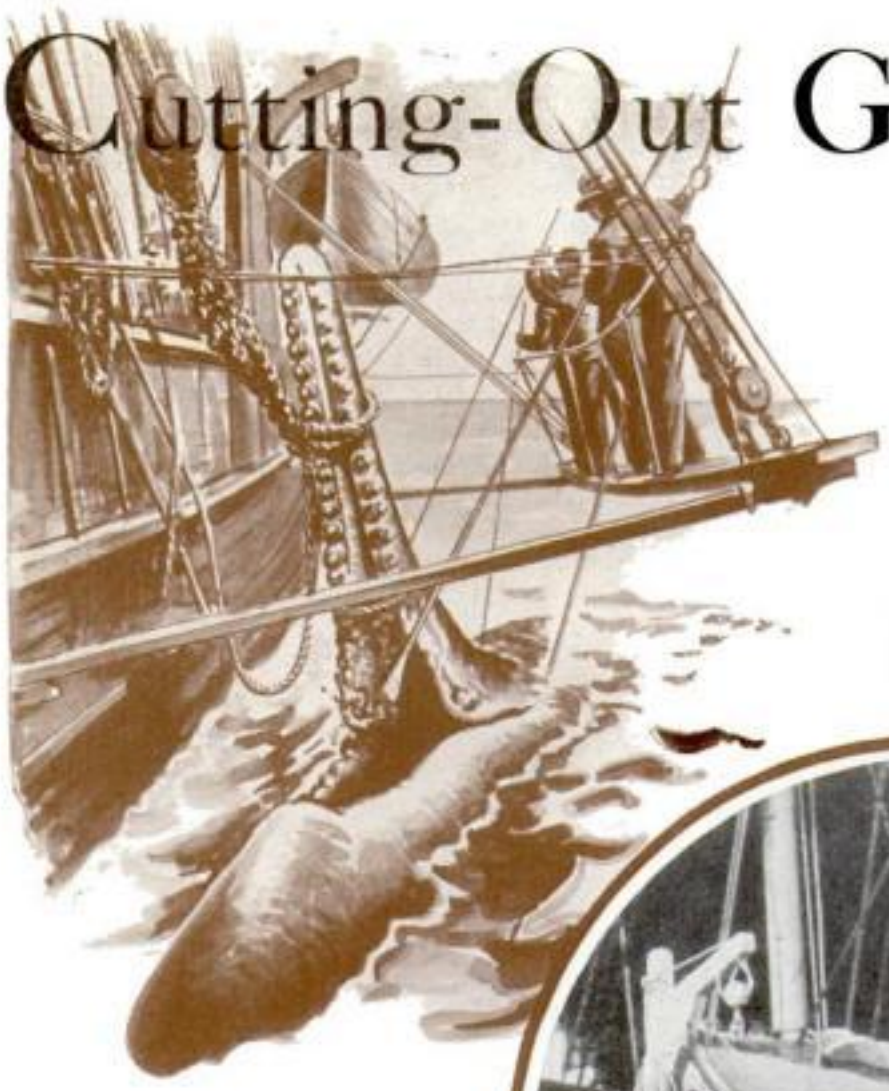
How the holder is assembled and mounted

Cutting-Out Gear *and* Whaleboats

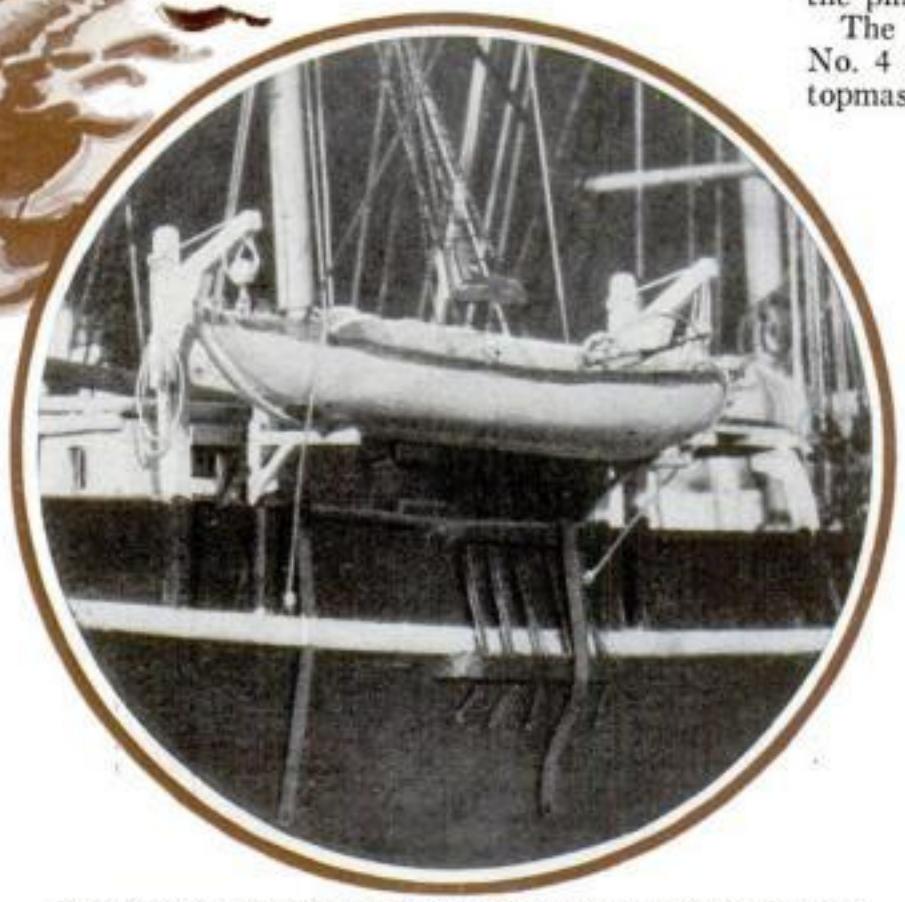
COMPLETE OUR MODEL OF THE

Wanderer

By Capt. E. Armitage McCann



How a whale was cut up into pieces small enough to be hauled aboard the *Wanderer* is illustrated at the left



The whaleboats are painted white with brown gunwales. Note the two metal skids against which the boat rubs when being hoisted

EXCEPT for some additional rigging and the making of the whaleboats and cutting-out gear, little work remains to be done on our model of the famous old American whaling bark *Wanderer*.

For the benefit of those who have not read the previous articles in this series (P. S. M., Apr. '32, p. 75; May p. 83; June p. 83), it should be pointed out at once that complete full size drawings of the model can be obtained by sending one dollar for POPULAR SCIENCE MONTHLY Blueprints Nos. 151, 152, 153, and 154 (see page 100). As a further aid, the Popular Science Homecraft Guild offers at a reasonable price carefully prepared kits containing all the necessary materials for building the model except the paints (see page 96 for a description of the kit).

To continue with the rigging: The lower topsail yards are put in position with their trusses; then the upper topsail yards should be fitted. They have single lifts of No. 2 line between the crosstrees. The tie of the halyards is of chain, and it is the length of the hoist. To this is fastened a single 3/16-in. block. A piece of cord starts at the top, is reeved through this block, and ends in a triple 3/16-in. block. To the deck a double block is bolted in the wake of the topmast backstays, and through these the fall is reeved. The fall comes down to port at the fore and to starboard at the main. The halyards of the yards above reverse this order each time. When there are no sails, the yards are lowered almost to the caps.

Next come the downhauls. These are reeved through a hole through the yard outside the eye band, with a knot above; then through the block on the lower yard, through the block under the upper, next through the quarter block, and down through the two lubber holes to the deck.

Both fore topmast yard braces start with hitches on the main stay, reeve through the pendant blocks and through double blocks hung from the trestletrees abaft, and down to the pinrail. At the main they start at an eye on the mizzen-mast, pass through the pendant blocks and through double blocks seized to the eye of the mizzen stay, and continue to the pinrail. All are of No. 3 cord.

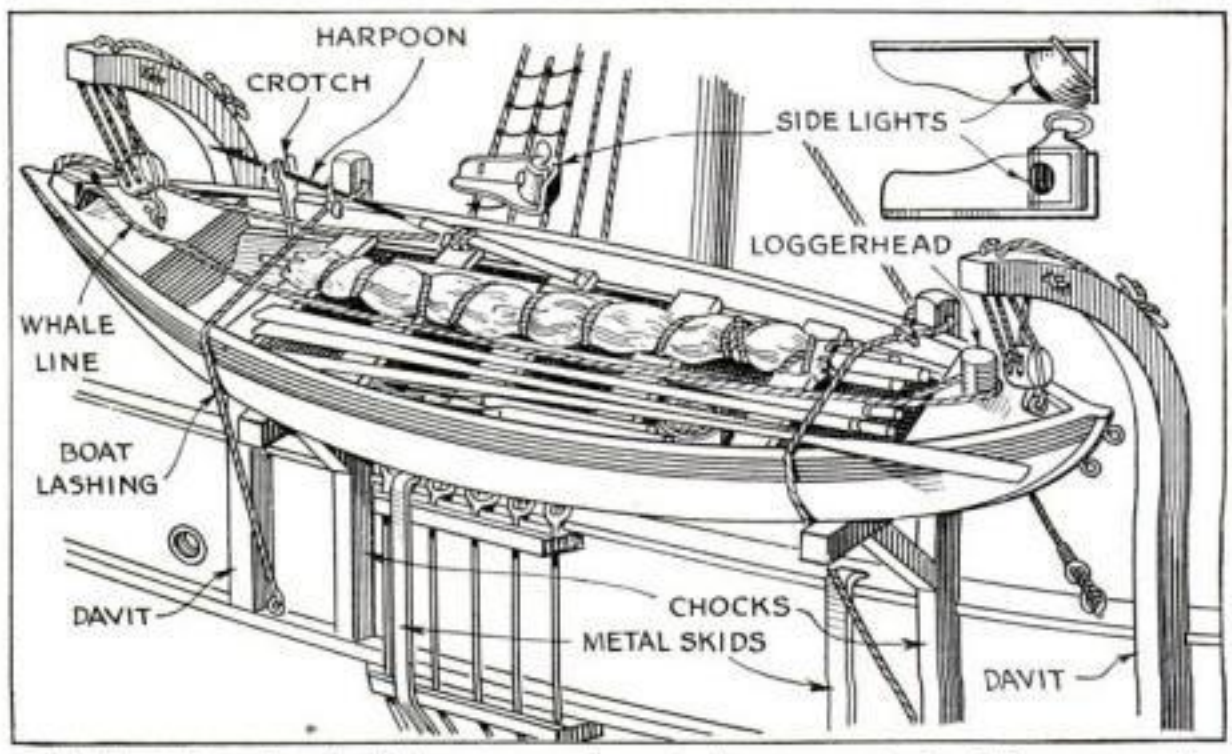
The fore topgallant braces, which are No. 4 cord, start at the eye of the main topmast stay, reeve through the pendant blocks, through double blocks at the eye of the topgallant stay, through double blocks hung from the after trestletrees, and down abaft to the fife rail. The corresponding braces at the main start at the mizzen cap, pass through the pendant blocks, through blocks on the mizzen topmast stay, and to the mast pin band.

The royal braces start at the yardarms, reeve through the blocks at the topgallant mast heads, and are carried down the mast.

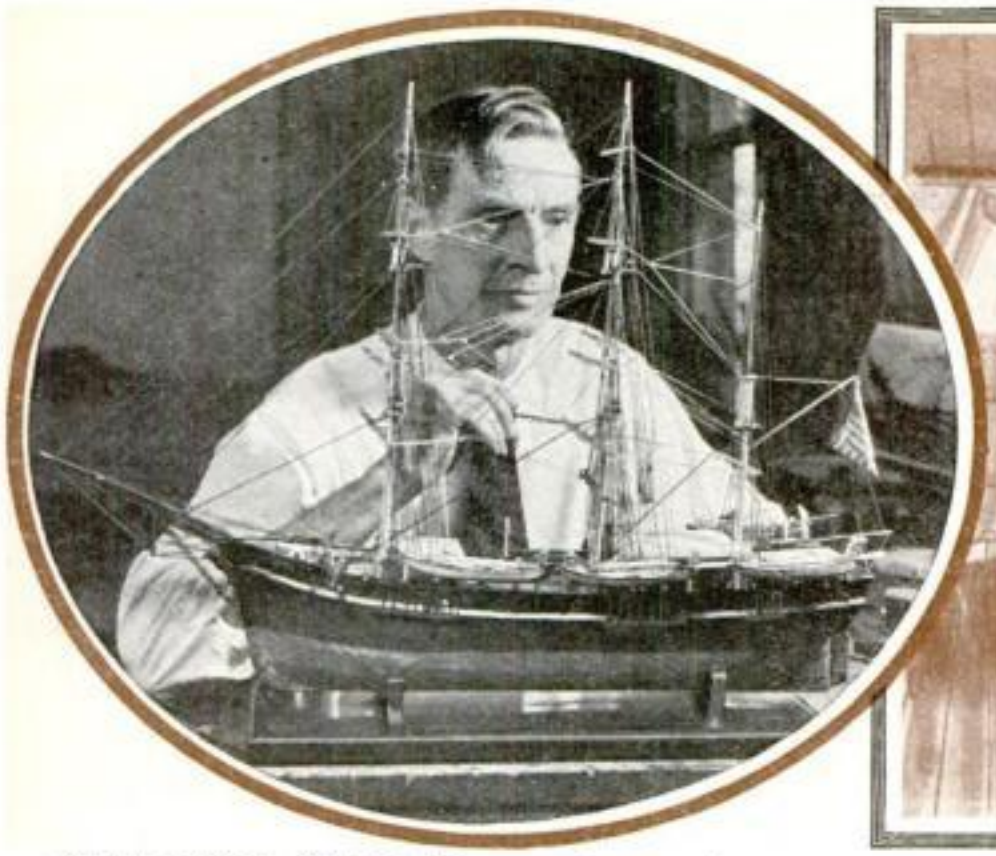
The topgallant halyards are chain, to which is spliced a piece of No. 2 cord, finishing with a tackle having two double blocks. The royal halyards can all be No. 3 cord, finishing with two single-block tackles.

The spanker gaff is hung with a chain span from the cap, the chain being painted white. On both sides are the vangs, which are single cords ending in two single-block tackles, bolted to the cap rail at the corners.

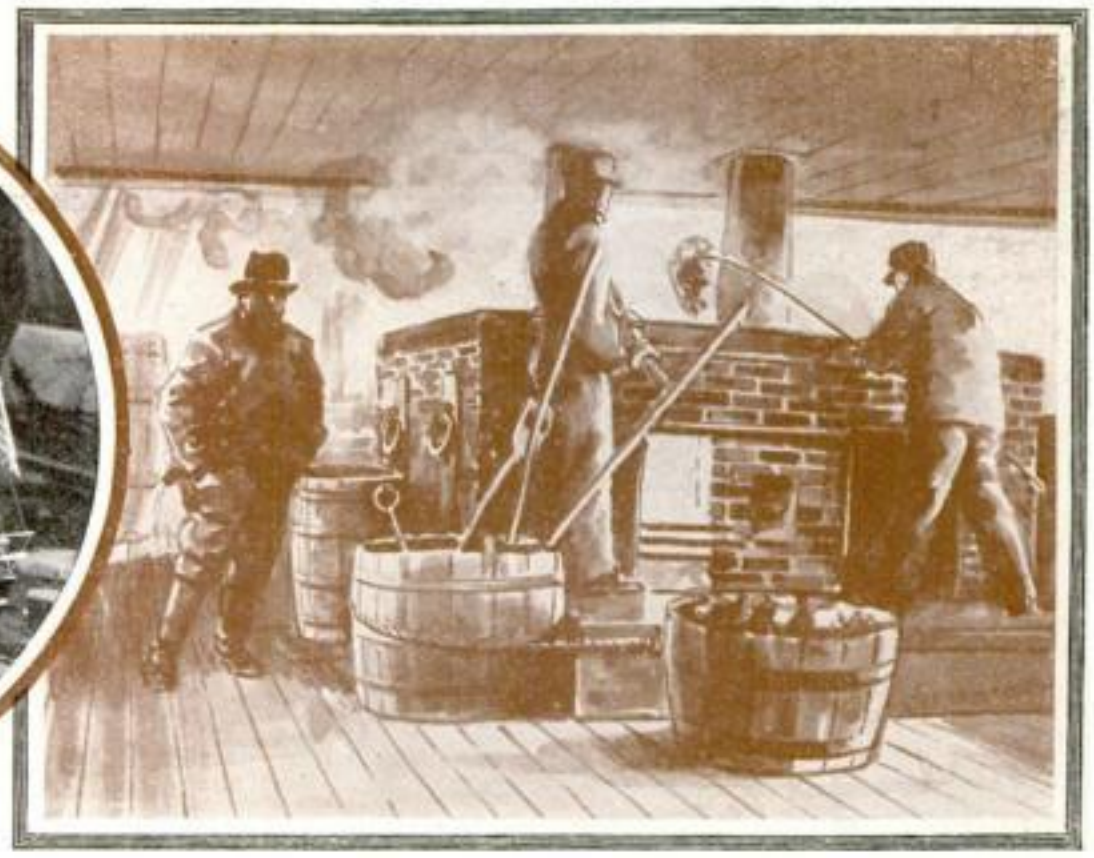
The boom end hangs on a cord span from the gaff; and the sheets start at the end, reeve through blocks bolted to the cap rail, through blocks at the inner band



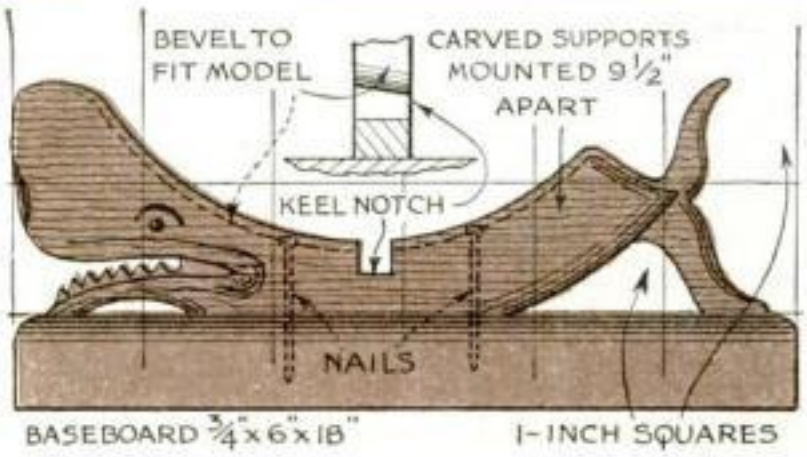
Each boat is equipped with thwarts, oars, long steering oar, mast and sail, harpoons, and crotch. The keel rests on two chocks which in actual use could be swung against the hull



Captain McCann finishing the *Wanderer's* rigging. His next articles will be on sail making



This drawing gives a good idea of how the stripped off blubber was rendered in the try-works



The original *Wanderer* model is supported on two grotesque whales fret-sawed and whittled from ½ in. thick wood

of the boom, and down to cleats on the waterways. The ensign has halyards reeved through a small eye in the gaff end. The house flag is as shown on Blueprint No. 153, except that the red ball is on a blue ground. The black W is on a white ground. The W part goes toward the halyard.

All of the above "running gear" on the real ship is manila rope; for this I therefore lightly tint white cord. The pendants are white and all the blocks white except the halyard and vang blocks, which are brown or black. The halyard ties, vangs, cord span, and lifts are black.

The whaleboats are made as shown on Blueprint No. 153. An eye is placed in each end; to this is hooked a double block. Before placing them, two chocks must be made for each boat. The keel rests on these. Then strips of thin brass must be nailed from the upper channel or cap rail to well down on the hull to serve as skids.

When the boat is in position, tie a cord to an eye in the white strake or to a dead-eye chain and bring it up, hitching it to a hole through the top of each swing chock in order to lash the boat down tightly. Then tighten the falls.

Side lights, green to starboard and red to port, should be fastened to the mizzen rigging above the davits.

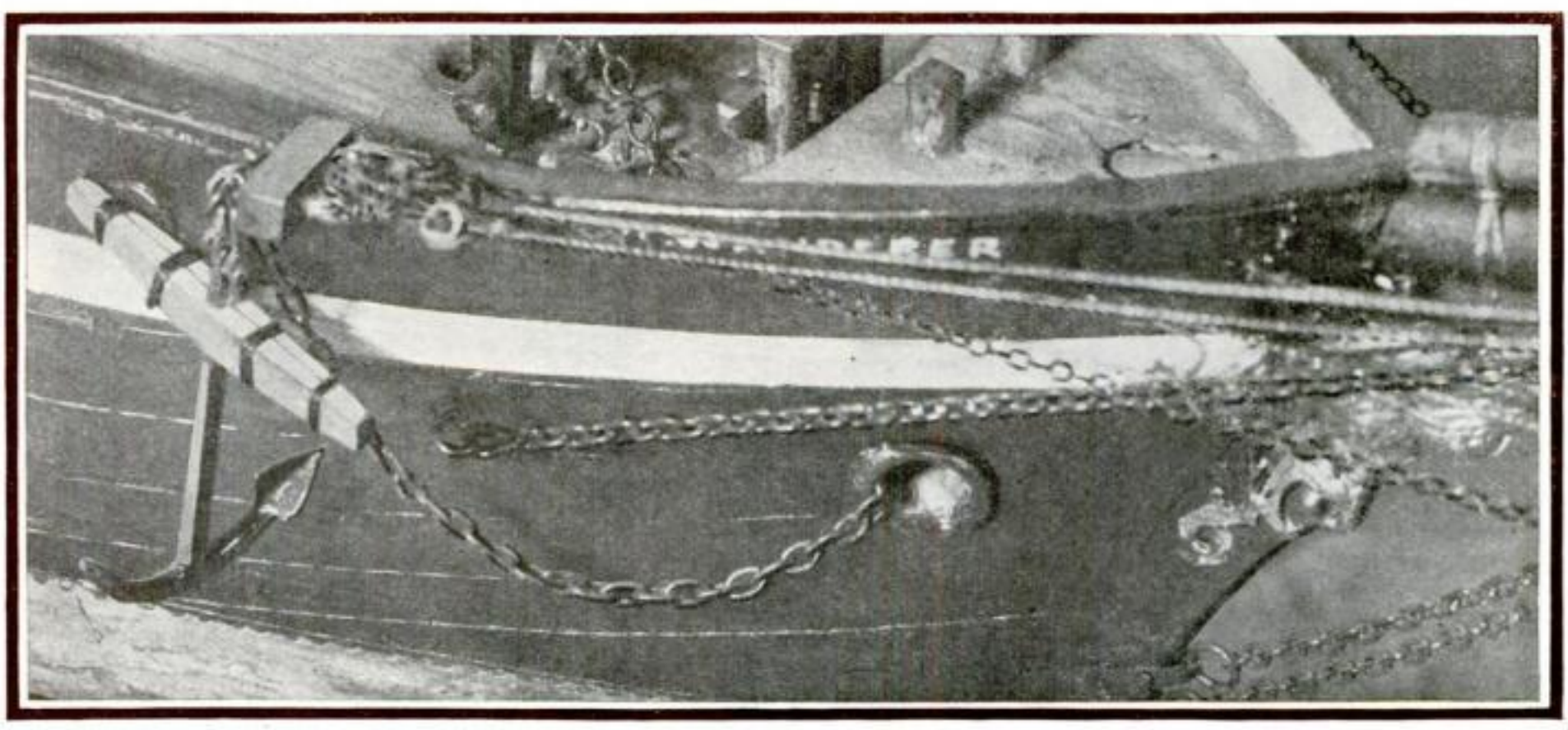
The anchors are the usual pattern with wood or iron stocks, the shanks being about 1½ in. long. They can be hung from the catheads or be lashed inboard.

The model will not be complete without the cutting-out gear, with which the whale is stripped of its blubber. This is shown clearly on Blueprints Nos. 153 and 154 and is also illustrated on page 74. The platform is hinged to the bead and is hung from a block on a post at the fore end and from a block in the rigging at the after end.

Three peculiar tackles rigged as shown on Blueprint No. 152 are hung from bolts under the maintop.

The drawing above shows how I made an attractive base for my model.

If you wish to put sails on your model, do not start the rigging until you have read the sail-making article in the August issue.



This unusual photograph of the bow of the model, which is somewhat larger than full size, shows how the anchors are made and hung from the catheads. If preferred, they may be lashed inboard

A NEW AND BETTER FLYING MODEL OF THE

Nieuport XVII

Famous World War Pursuit Ship Flown by Guynemer, Nungesser, Lufberry, Hall, and Other Aces

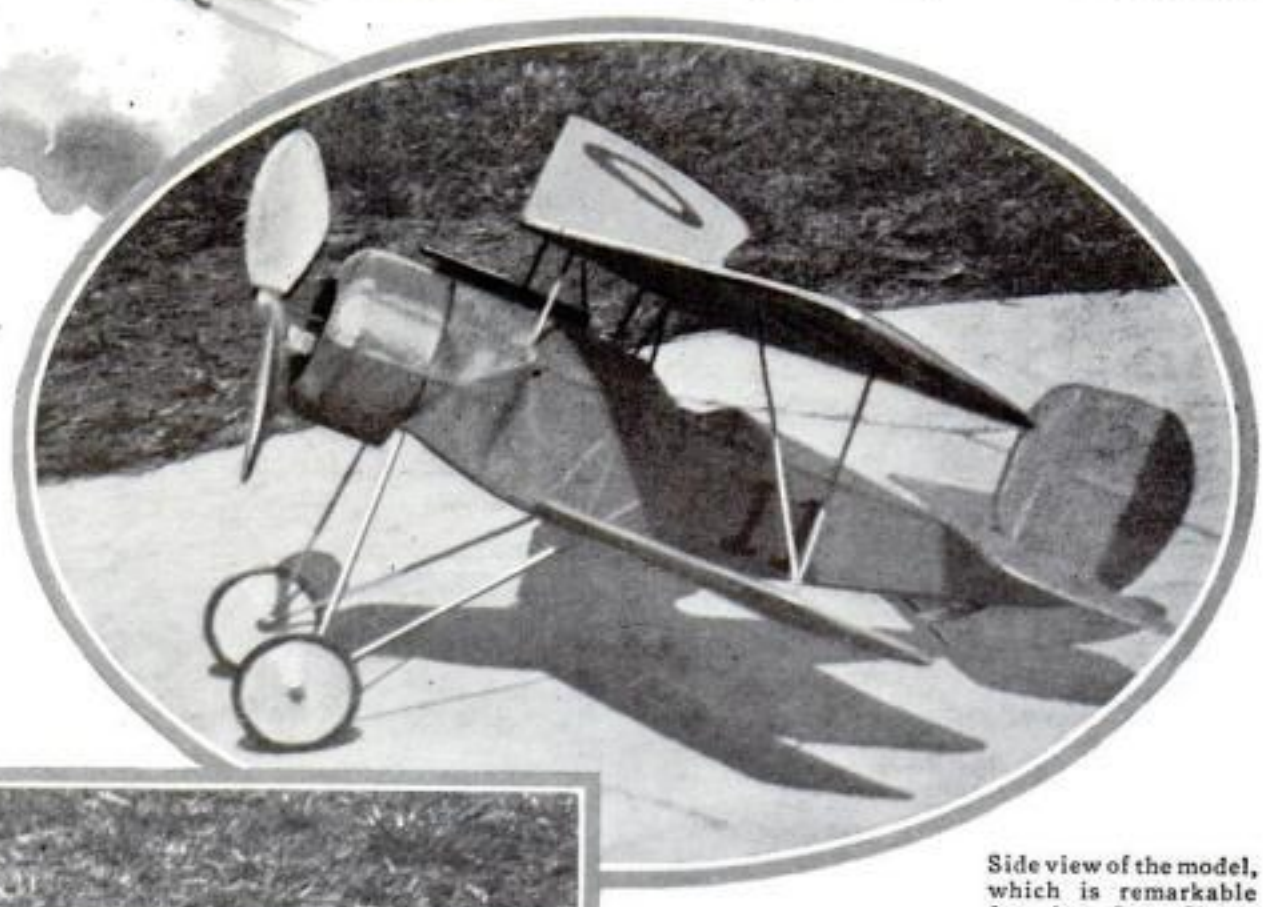
By J. DANNER BUNCH

Airplane model makers are turning their attention to those historic ships that battled on the Western Front. One of the greatest of these was the Nieuport

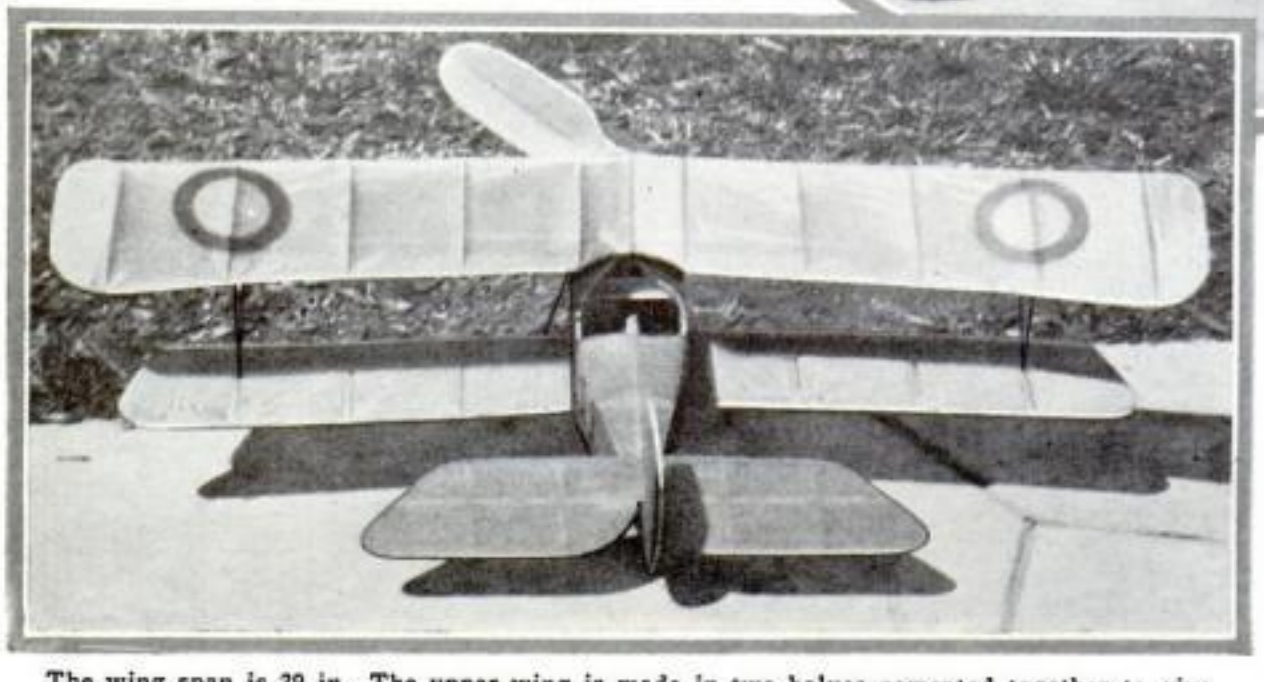
A FAST and nimble fighter was the Nieuport. It was the first outstanding pursuit ship used by the Allies during the World War. Guynemer, Nungesser, Lufberry, Fonck, Hall, Chapman, Prince, and others flew it with amazing success.

This new model of the Nieuport XVII, which has a wing span of 29 in., is a beautiful little ship in the air and very stable. It will make remarkable flights, floating up to high altitudes. The construction is simple and should give no trouble even to relatively inexperienced model makers, especially if they send fifty cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 180 and 181. These contain much larger and clearer drawings than can be printed in the limited space of a magazine page and are accompanied by a long bulletin giving more detailed building, testing, and flying instructions. A coupon for ordering appears on page 100.

It is important to study the drawings carefully and keep closely to dimensions so the finished model will be light and correctly balanced. The fuselage is constructed almost entirely of 1/16 in. square medium hard balsa. Make a full size drawing of the side view and form a jig of ordinary pins along the lines to hold the



Side view of the model, which is remarkable for its fine flights



The wing span is 29 in. The upper wing is made in two halves cemented together to give a dihedral of 5 deg. The lower wings, which are held with pins, have a dihedral of 7 deg.

longerons and struts in place. Do not, however, push the pins through the wood. The lower longerons at the front have a fairly large curvature and should be soaked in hot water about three minutes before bending them in the jig. Allow the longerons to dry thoroughly; then assemble the remaining struts, longerons, sub-longerons, and diagonals. All joints are then secured with model airplane cement.

Remove the fuselage side when the cement has dried and build the opposite side in the same manner. Set up the two sides and install the horizontal struts. Align carefully by sighting with drafts-

Driven by its rubber-band motor, the model soars away like a real plane. How realistic it looks can be judged by the striking photograph at the right. It will make either rise-off-ground or regular hand-launched flights

men's triangles or along the struts. Because of the abrupt bend at station *C*, the lower longeron must be cut and reassembled with a butt joint, well cemented. The fuselage now leaves the jig as a rigid unit.

The reënforcing and landing gear struts are next cemented in place as indicated.

Cowling formers of 1/32 in. sheet balsa are cut for all stations except those which support the nose ring at *A*.

The wings are made in four sections, two upper and two lower. The lower wings are held to the fuselage by wing pins. The upper wing is secured to the center section struts by hooks which engage the loop clips on the struts.

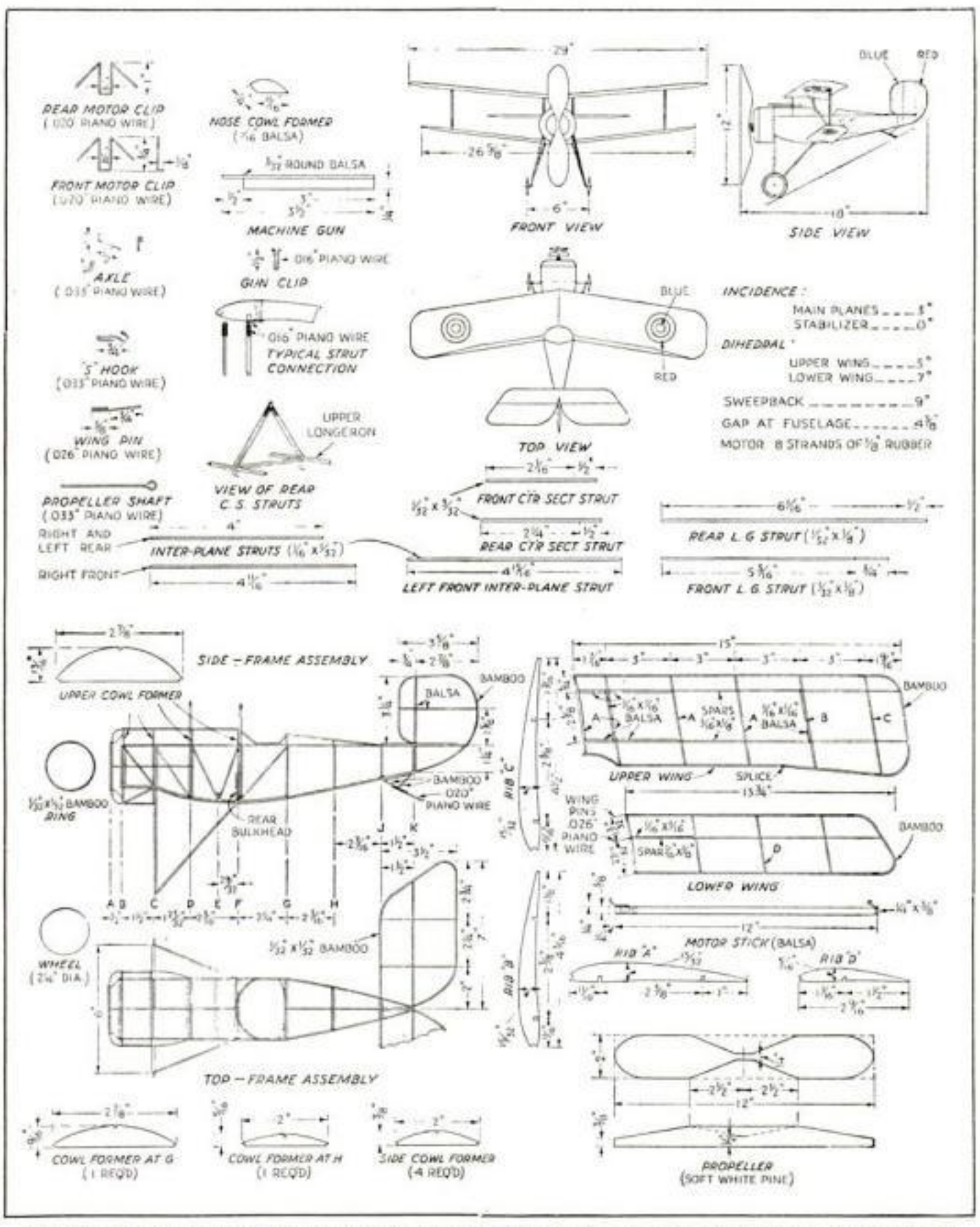
Make full size paper patterns of all ribs and trace the outlines on 1/32-in. sheet balsa. Cut out the ribs with a razor blade. Locate the spar notches accurately. Draw the wings full size in plan view and form a jig of pins to locate the edges, ribs, and spars. Cement all joints except the inner ribs. The spars and trailing edges are 1/16 by ⅛ in. balsa. The leading edges are 3/32 in. square balsa. Next make the wing tip outlines of 1/32 in. square bamboo and install them. Cut the spar tips from 1/32-in. sheet balsa and cement them in place. Block the tips to allow a 5-deg. dihedral on the upper wings and 7 deg. on the lower. Set the inner ribs in place so the sides are vertical and cement the joints. The two halves of the upper wing are fastened together with plenty of cement.

The stabilizer and rudder are assembled over full size drawings.

The motor stick is ¼ by ⅜ by 12 in. balsa. The motor consists of eight strands of 1/32 by ⅛ in. model airplane rubber. The propeller is carved from a block of soft white pine, the blades being cut thin enough so that light can be seen faintly through the major portion of them. Balance it carefully and finish with several coats of banana oil.

The covering of the model is Japanese tissue paper. The dope is made of one part banana oil to three parts acetone. To avoid distorting the framework the covering should be doped before it is applied to the model.

The gun, wheels, center section struts, outboard struts, and landing gear struts are given two coats of banana oil, and the decorations completed with a coat of black lacquer on the gun and on the rims of the wheels to represent rubber tires.



To help those who have not had much experience in building models of this advanced type, our Blueprints Nos. 180 and 181 have been prepared with larger drawings. These are accompanied by detailed instructions

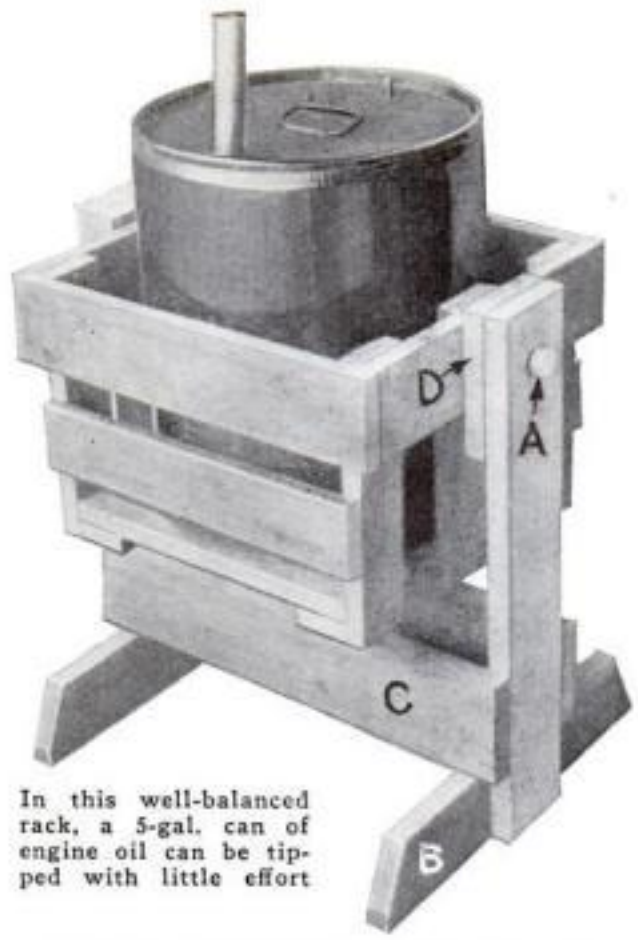
RANGE FINDER FOR FOCUSING CAMERA

How the range finder is held is illustrated in the photo above. The drawing at right explains the construction. The brass arrow, of course, must be able to swing freely

A SIMPLE, easily made range finder that will enable the photographer to snap properly focused negatives can be made of the following: one piece ¼ in. thick and 2½ in. square and another ½ in. square and 1 in. long, preferably hardwood; one piece of sheet brass 1/16 by ¼ by 2 in.; three roundhead (or fillister head) wood screws ½ in. long; one flathead wood screw ½ in. long; and one small brass or iron washer.

The largest piece of wood is cut as a quarter circle with a radius of 2½ in. The smaller piece is screwed to the back and serves as a handle. The brass is filed to the shape shown and attached loosely with a roundhead screw to the quadrant ½ in. from each straight edge in the position indicated. The washer is placed between the wood and the arrow. The remaining roundhead screws are set in the edge of the piece so the slots will serve as sights. The scale is made by holding the finder to the eye, sighting through the two screws at points on the ground a measured distance away, and marking where the arrow hangs.

If carefully calibrated, this finder will give quite accurate results when used on level ground. It makes no difference whether it is held close to or a foot or so away from the eye, but if used by a taller or shorter person than the one who calibrated it, there will be a slight error.—RICHARD SERVIS.



In this well-balanced rack, a 5-gal. can of engine oil can be tipped with little effort

CONVENIENT SWINGING RACK FOR OIL CAN

THIS swinging rack, made of pieces salvaged from packing cases, has simplified the handling and storing of engine oil in one family's garage. Assuming that the rack is to hold a 5-gal. can of the size and type illustrated, the inside should be 12 in. square and about 9 in. deep. The center pin *A* should be about 7 in. above the bottom of the can, and about 18 in. from the floor. The feet *B* are 3 in. wide and 15 in. long, and the stretchers *C* are 4 in. wide. Piece *D* was nailed to the standard merely to provide ample bearing for the center pin.—CHARLES A. KING.

ROUND-CORNERED CARDS

PHOTOGRAPHS and any other square-cornered cards or papers can quickly be given clean-cut round corners with a wood gouge and the equipment shown. The gage consists of a flat baseboard to which are screwed two pieces of wood at right angles. To insure a perfectly clean cut, a strip of heavy cardboard should be placed under the pictures.—KENNETH MURRAY.

The corners of a dozen cards or prints at once can be trimmed round in this device

EASILY ASSEMBLED FURNITURE LEGS

WHEN furniture legs are made from solid stock and fastened to the other members of the framework with doweled or mortised joints, they often prove a source of trouble and vexation to amateur woodworkers. Any lumberyard, however, can provide ¼ by 1¼ by 1¼ in. corner molding, and also suitable square stock, which will just fit inside the molding, and the accompanying sketch and photograph make plain how these are used.

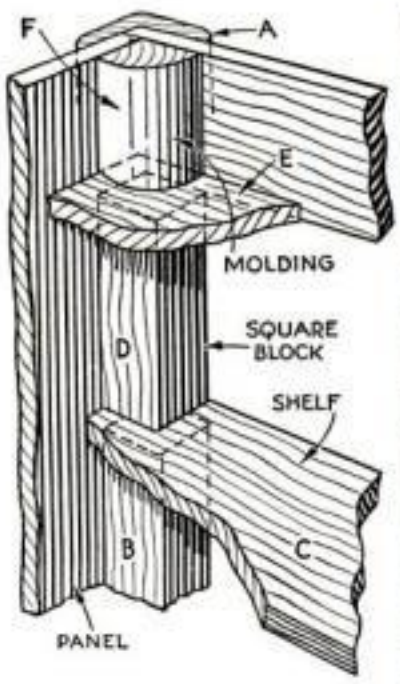
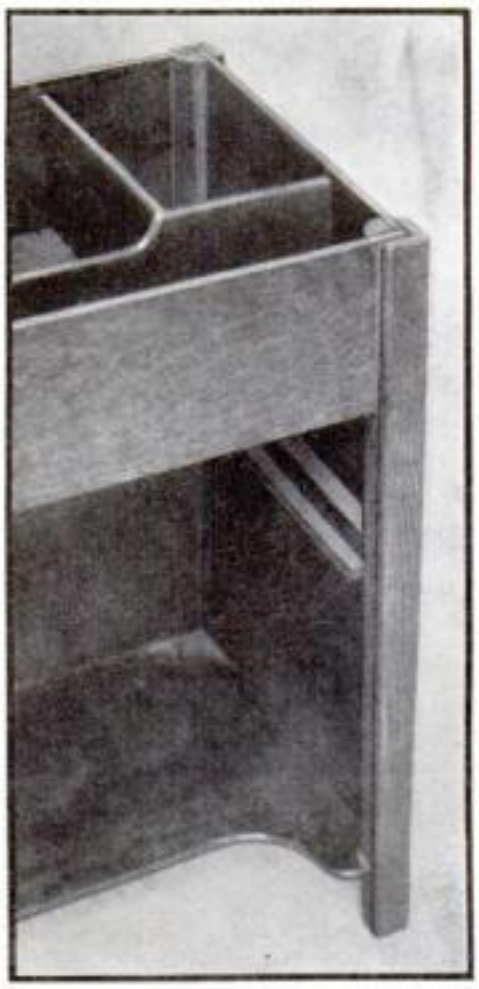


Diagram to show general principle of building up almost any type of plain furniture leg. Part *A* is a standard corner molding



At the right is a photograph of one end of an open-top sewing cabinet with legs of this variety

For a sewing cabinet such as the one illustrated, a ¾ in. square block *B* is cut a length equal to the distance that the lower shelf is to be from the floor. It is then glued and bradded into the lower end of corner molding *A*, which is the full length of the leg. Three similar legs are prepared, and the shelf is glued and bradded into the legs at the corners, resting upon the blocks *B*. Another block *D* is fitted into each molding *A* above the shelf *C*, and above that are placed the tray bottom *E* and front panel of the cabinet. In this case a quarter-round molding *F* was used instead of the square stock to reënforce the tray corners at the very top.

Almost any furniture leg of plain design may be constructed by a variation of this simple kink, and the resulting legs will be strong.—CLINTON F. BLAKE.

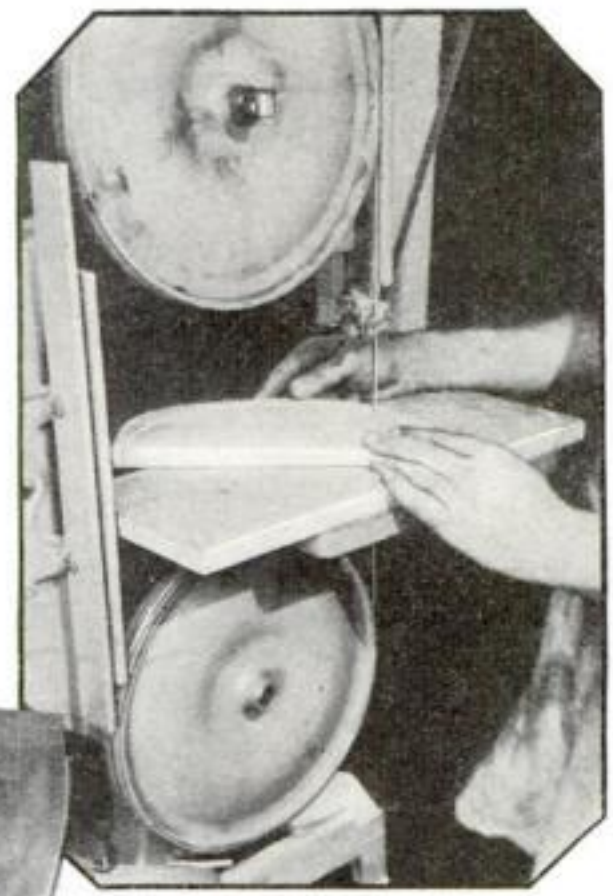
Mahogany and Silk Enrich This

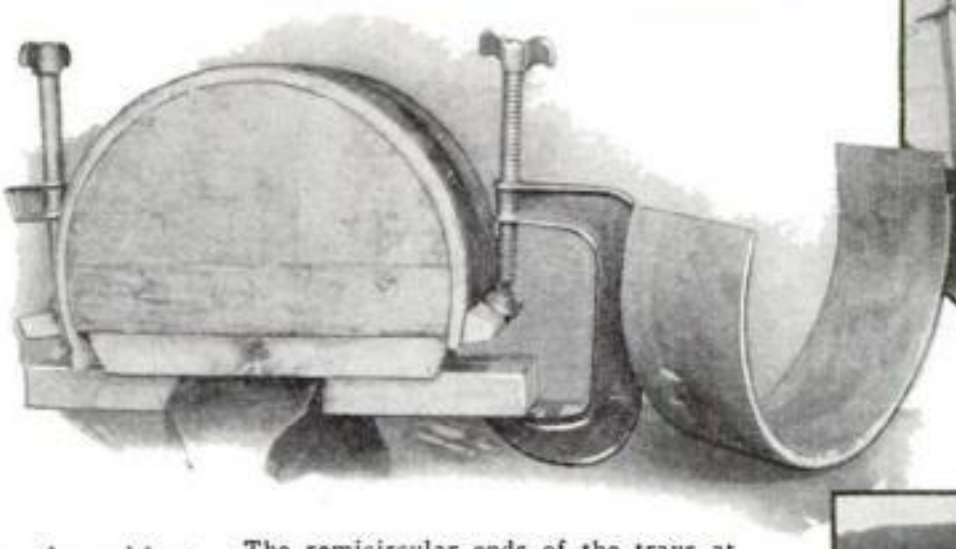
Dainty Sewing Cabinet

DESIGNED IN THE GRACEFUL STYLE OF 1812

By *Donald* A. *Price*

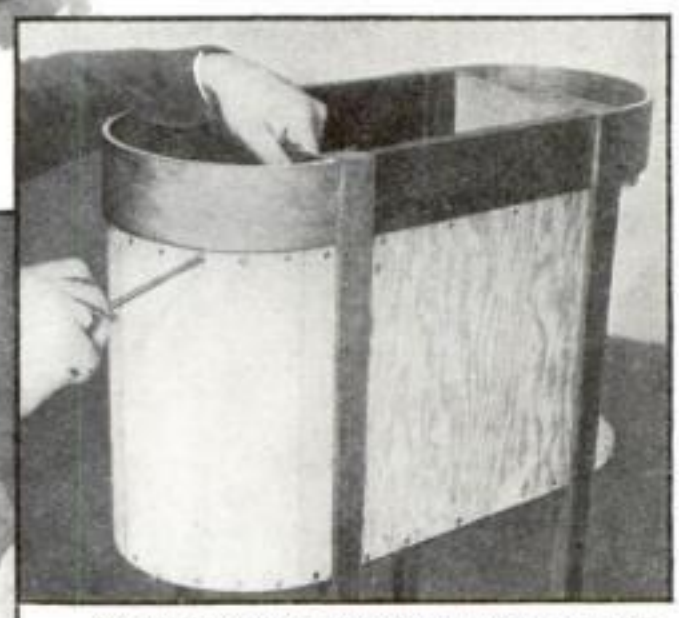
Few cabinets will hold as much as this without conveying a sense of bulk or weight





If a band saw or jig saw is available, the curved parts can be cut accurately by swinging the work on a pivot pin

The semicircular ends of the trays at the top of the cabinet are made by veneering a pine core with mahogany on both sides over a form as shown above



The main curved end pieces, which are pine with the grain vertical, are screwed in place

A box pleat is sewed in the upper and lower edges of the silk, which is then fastened on with suitable gimp and upholstery tacks

THIS sewing cabinet, patterned after one built about the year 1812, is an unusual project for the home craftsman, and when completed it will be a welcome gift because of its beauty and capacious storage space. Women appreciate the daintiness of the pleated silk which covers the lower portion of the sides and ends.

In its outward appearance, the cabinet closely resembles the original, but the construction has been modified so that shallow half-round end compartments are provided for thread, needles, and other small articles. This construction also gives the cabinet a built-in sturdiness not apparent at first glance. Being of simple lines, it is not difficult to build; the curved ends present the only problem in construction at all out of the ordinary.

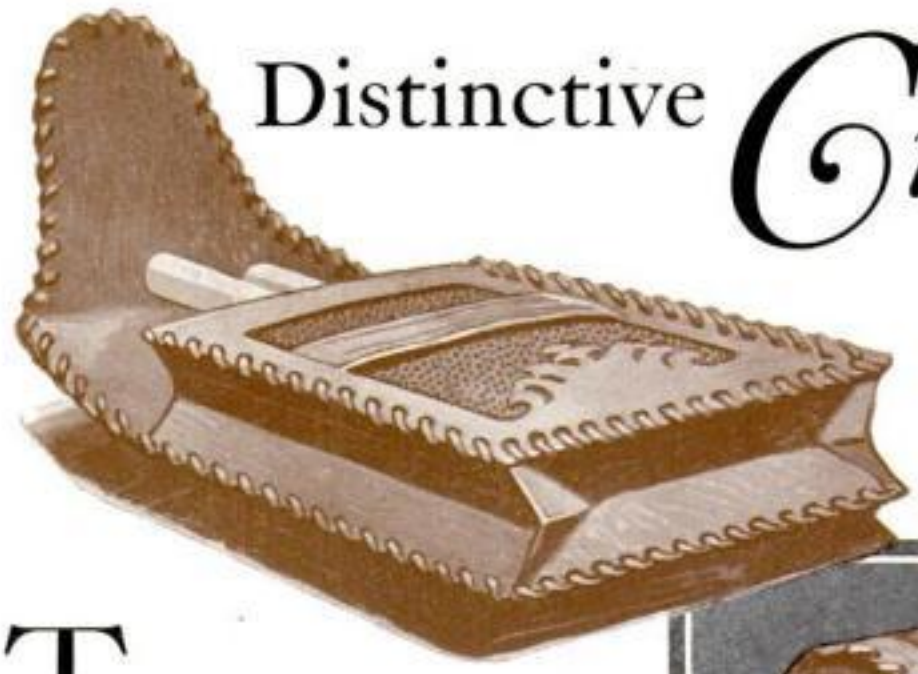
It is probably advisable to start the construction of the half-round end compartments; then, during intervals of waiting for the glue to set, the other parts may be prepared. As shown in the small perspective sketches on page 98, the curved side of each end compartment is formed of two pieces of 1/28-in. mahogany veneer 3 in. wide and 17 in. long, between which is glued a ¼-in. white pine core with the grain running vertically. As it is not practicable to obtain this core in one width of 17 in., it must be made of narrower stock joined preferably with a half-lap joint. This should be done, using casein (waterproof) glue, before steaming and bending the core to the approximate radius. In this case an old oil can about 10 in. in diameter served as a form on which the steamed wood was tied and clamped till thoroughly dried, when it was found to have taken a permanent set of practically the correct curvature. This method was also followed in preparing the curved ends marked No. 6 in the drawings.

This preliminary bending of the core makes it easy to handle when gluing on the veneer. A form is built up about 3¼ in. thick and cut to a true radius of 5¾ in. This, as well as the other circular parts, can be cut on the band saw by using an auxiliary wood table with a pin in it set 5¾ in. from the near side of the saw, so that the blank can be pivoted on the pin in cutting. (One of the photographs shows the stop *(Continued on page 98)*

From a Few Remnants of Leather You Can Make This

Distinctive *Cigarette Case*

By F. Clarke Hughes



THE decorative leather case illustrated is intended to hold a standard sized package of cigarettes. With only a slight increase in size, the case may be used for a single pack of playing cards.

Although a case of the dimensions given will fit any ordinary package of cigarettes, the reader should take the precaution to prepare a paper pattern of his own around an unopened package of his favorite brand. The case should fit a new package snugly; its sides will then become gradually flattened as the contents are depleted. When nearly empty the case is quite thin.

The leather known as "tooling calf" is the most satisfactory, but other suitable varieties can be chosen from the stock of any leather findings store or shoemaker's shop. Because the tooling is fairly deep, it is especially desirable for this project to obtain a good grade of tooling calf. The leather may be purchased either in one piece 3¾ in. wide by 10 in. long or separately as remnants, whichever proves to be the cheaper way.

In constructing the case there is nothing essentially different from many similar problems described in past issues of Popular Science Monthly. The holes for the laces should be 3/16 in. apart, placed ⅛ in. from the edge. The laces should be from three to four times the length of the edges to be laced.

The strap across the front of the case is ½ in. wide, and the ends are put through slits in the front and glued with a turn-under of about ¼ in. These ends should be skived to a featheredge before being glued.

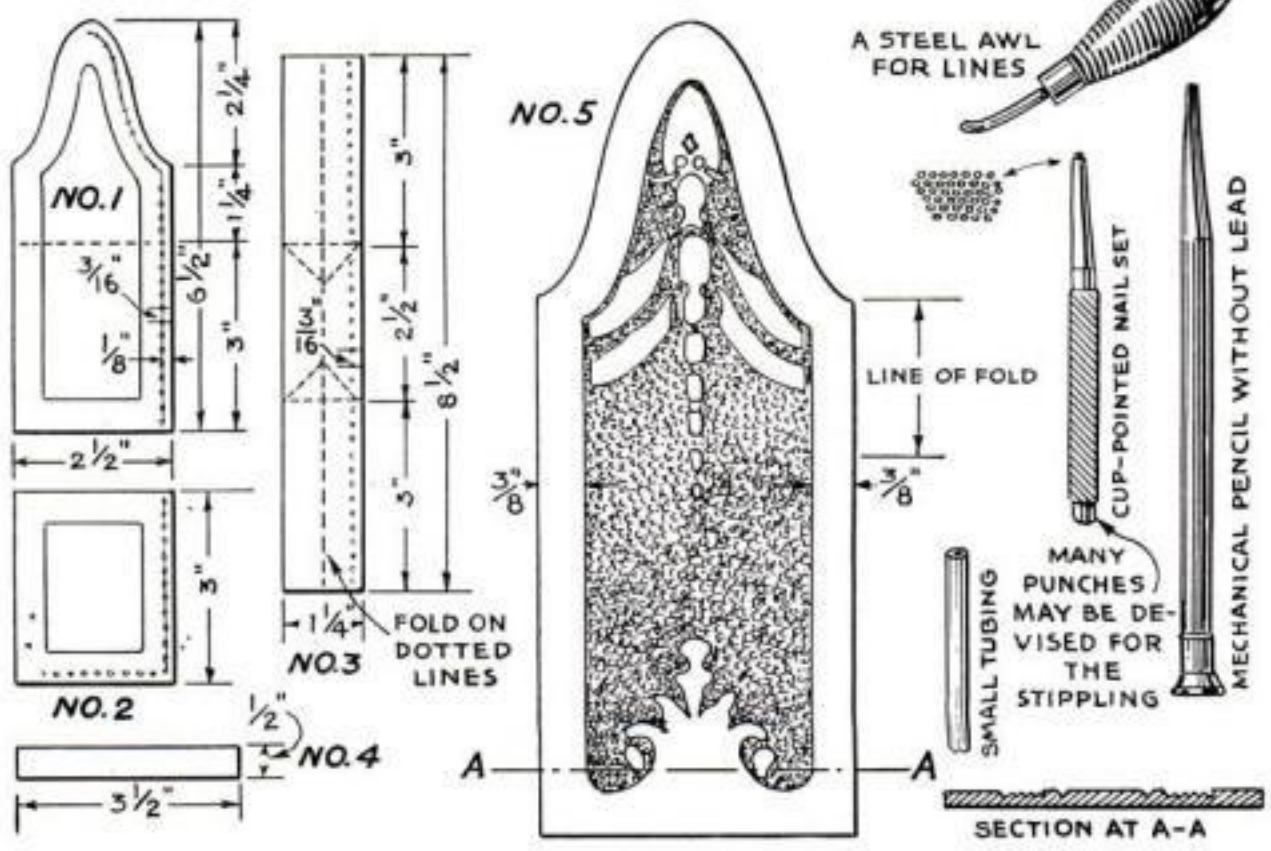
The tooling should all be done before the sides are laced. The design suggested is one appropriate to this type of problem; however, the reader may follow the same method of tooling with any similar type of design he may wish to substitute.

First outline the form with a lead pencil on the dampened surface of the leather. These lines should then be tooled over with a steel awl until quite deep. The stippled portion is next put in with the hollow end of a nail set, or any desired kind of punch may be made and used as shown in one of the photographs. Care must be taken to avoid hitting the punch too hard and driving it through the damp leather. The front, of course, is tooled to match the back. The center of the strap should have just the suggestion of a design in the way of either a small veined outline or a stippled panel.

After the tooling is completed and the leather is thoroughly dry, the edges should be laced with ⅛-in. lacing. These laces may either be purchased or cut spirally from a piece of thin stock such as kid or wallaby. Where this lacing may be purchased already cut to size, it is best as a rule to buy it, because the width is much more uniform than the hand-cut material and the cost is, in most cases, only a few cents a yard.

When the case is finished, the edges may be gone over very lightly with a coat of shellac, which serves to glue together the edges and keeps the laces in place. It also slightly stains the lighter colored edges that otherwise might appear a little out of harmony with the surface finish of the stock. After the shellac has dried, the entire case should be polished with a good shoe dressing or floor wax.

Three views of the hand tooled cigarette case are given above; the method of punching the background is shown at the left; the working drawings appear below with sketches of the tools



APPLYING PASTE WOOD FILLER EXPERTLY

FLOORS and other surfaces made of such open grained woods as oak, walnut, and mahogany are usually filled with paste wood filler after being stained and before the final finish of varnish or wax is applied. The handling of paste wood filler is easy if the right method is used, but the wrong procedure produces a cloudy, unsatisfactory finish.

Most of the paste filler used today is purchased in a very thick form and must be thinned to about the consistency of cream with turpentine or benzine to make it ready to apply. It comes in several colors such as natural, walnut, mahogany, light and dark oak, and cherry.

Apply the thinned filler with a 4-in. brush or a large round brush, stroking with the length of the boards, not across the grain of the wood. Cover at first only about six boards all the way across the room. In from five to fifteen minutes, depending upon the temperature and ventilation, the filler will lose its gloss and is then ready to be wiped off. Do this immediately, otherwise the filler will dry too hard. Use a wad of excelsior and wipe across the grain of the wood. Rub the filler well into the cracks between boards. Leave no filler on the surface, as it will cloud the finish. Allow the filler to dry overnight. Then sandpaper it lightly and wipe it with benzine or turpentine on a cloth to clear up and bring out the wood grain.—F. N. VANDERWALKER.

WIRE PAPER CLIP FORMS EMERGENCY COMPASS

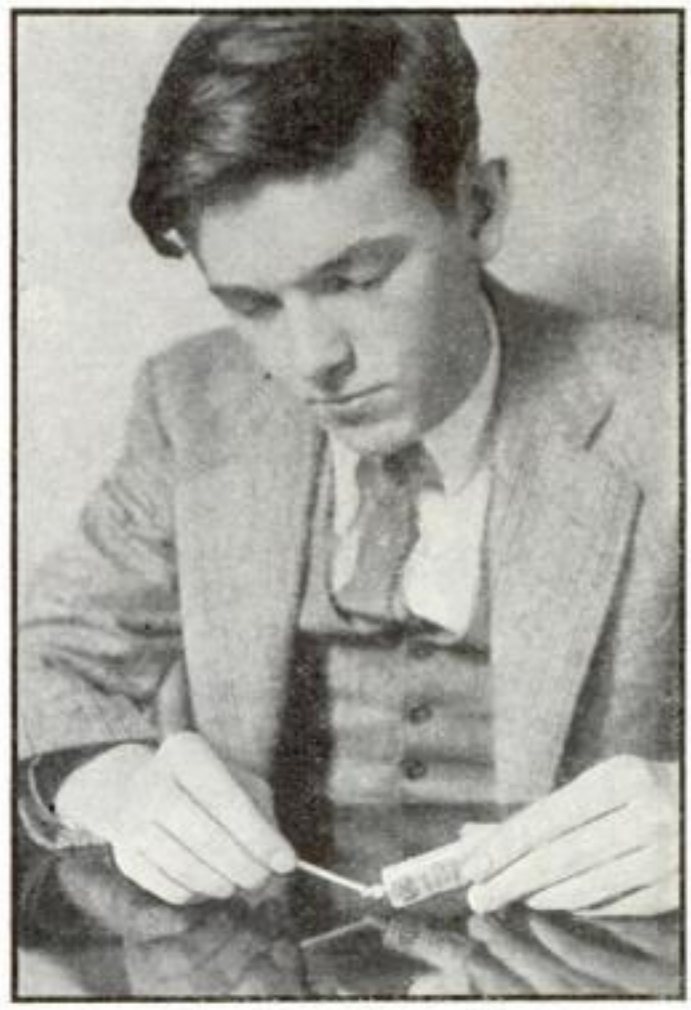
WITH an ordinary bent-wire paper clip of the type shown in the photograph at the right, together with a pin and a pencil, you can draw circles as accurately as with a compass in those emergencies when there is no compass at hand. Drive the pin into the paper far enough to hold firmly, and use it as a center. You can then swing in two sizes of circles without bending the clip; and by straightening it out to various degrees, you can produce any number of circles up to a diameter of about 4¾ in., provided the clip is of the fairly large size which is now commonly regarded as standard and not one of the smaller sizes. Of course, if a "giant" size clip is used, larger circles can be drawn.—R.E.

TRANSPARENT CEMENT CONCEALS DENTS

REFINISHING highly polished furniture by sanding and varnishing is comparatively easy for most home mechanics except for one thing. There often are small dents, especially on table tops, that extend right down into the wood, sometimes as much as 1/16 in. deep. It is not practical to sand deep enough to eliminate the depressions; opaque colored fillers, although excellent for other work, are likely to show; stick shellac requires considerable skill to apply and must be a perfect match; and varnish cannot be applied thick enough to fill more than the shallowest of the depressions. However, some of the transparent, quick drying, waterproof cements—those with a thick banana-liquid base—make possible a repair that is invisible after refinishing the surface with clear varnish.

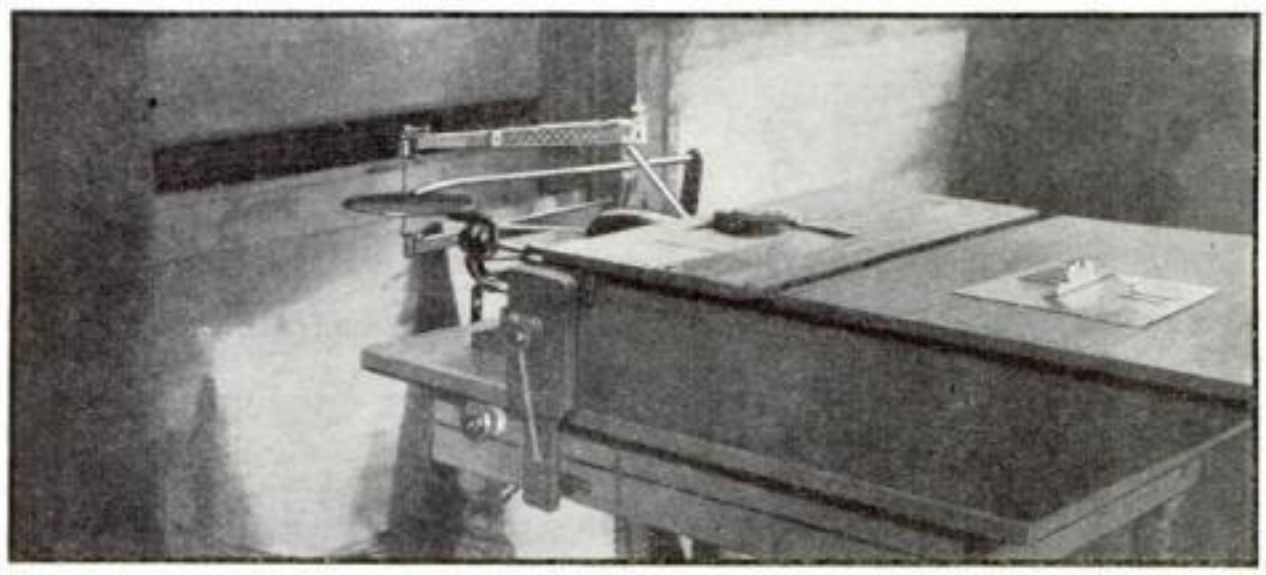
If the depression exposes lighter wood, stain it to match, allow the stain to dry, then, using the flattened end of a toothpick or match stick, press one or more large drops of the transparent cement into the dent. Be careful not to imprison any air bubbles, and use sufficient cement so that when it is dry it will more than fill the depression.

Let the cement dry thoroughly. This requires but a few hours with some of the quick drying banana-liquid cements. Then carefully sandpaper off the excess material, and sand and varnish the surface in the usual way.—G. M.

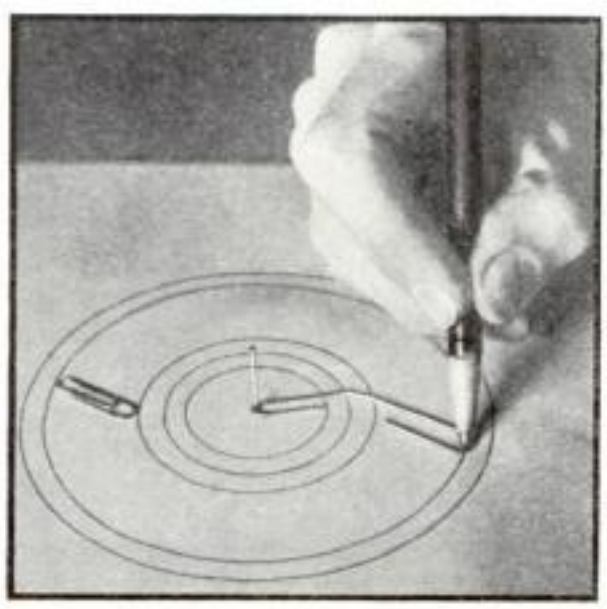


Filling small dents in a highly polished table top with household cement applied with a toothpick

OUTBOARD REST FOR SAWING LONG WORK



The slot in the partition at the left forms a support for long boards which must be crosscut



In the absence of a compass, circles can be drawn with the aid of an ordinary paper clip

MY HOME shop is only 10 by 12 ft., but in it I handle conveniently boards up to 18 ft. long, either for crosscutting or ripping. The illustration above shows how this is done. The circular saw is opposite the door from which the photograph was taken, and through that door long boards may extend while being ripped. In order to be able to crosscut long pieces, I cut a horizontal slot in the side partition of the shop through which to extend the boards. The table tops of the saw, jointer, and jig saw are all in the same plane; and the bottom of the slot is on the same level, so that it serves as a rest for the work.

The door opposite the circular saw might be made in two parts, with the top of the lower door also on the same level as the saw table top.—C.F.B.

USEFUL SUGGESTIONS *for* Auto Workers

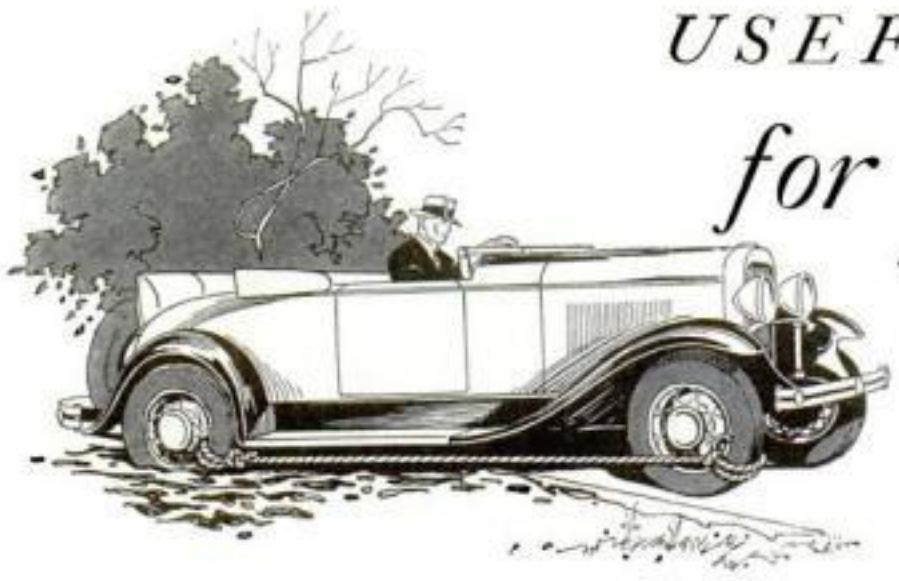


Fig. 1. By tying a rope from the rear wheel to the front one, a kind of four-wheel traction is possible to help a car out of mud when rear wheels sink in

A MUDDY road would have to be unusually bad to stall a motor car if it had four-wheel drive. You can take advantage of this fact the next time you get stuck. Figure 1 shows a way to obtain traction with all four wheels. Tie a rope to the front side of the rear wheel in line with the bottom of the running board. Fasten the other end of the rope to the front wheel at approximately the same point. Then if you let in the clutch with care, the front wheel will be pulled around for about a third of a revolution and the car will be pulled forward that far. If both of the rear wheels are mired, both front wheels can be roped in this manner. Of course, care must be used with this method, as the automobile can only be driven a couple of feet with one tying of the ropes.

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to B. Elkin, Woodside, Long Island, N. Y. (Fig. 3). Contributions are requested from auto mechanics, and if printed will be paid for at usual rates.

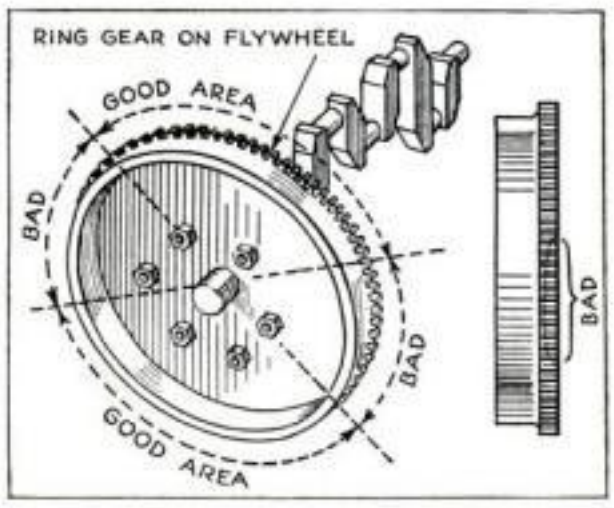


Fig. 5. This diagram shows how teeth wear on flywheel. Changing its position as shown brings unworn portion of its teeth into use

To Save a Flywheel

ON A four-cylinder motor, the effect of the compression is such that the motor almost invariably stops with the pistons about mid-point in their strokes. The result is that the teeth on two restricted portions of the flywheel gear take all the wear of the engaging starting pinion. In time, the teeth at these points become chewed away and the starter jams. The diagram in Fig. 5 shows how this works out. Note that plenty of good teeth are left on the flywheel. It is possible to remove the flywheel and bolt it in a new position sixty or 120 degrees from its previous location. This gives good teeth with which the starter pinion can engage, the worn teeth coming into action only after the pinion is all the way in. This operation will give you what practically amounts to a new flywheel.

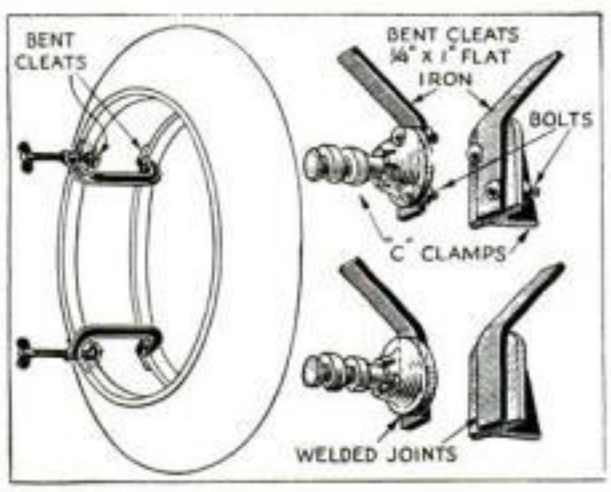


Fig. 2. Tire spreaders that are handy for heavy work are made of strap iron welded to C clamps

Tire Spreaders

FIGURE 2 shows a way to make tire spreaders that are helpful if you have much work to do on heavy tires. Obtain a couple of C clamps with an opening equal to the distance you want to spread the tire. Bend cleats out of strap iron as indicated and weld to the jaws of the C clamps or attach them by drilling 11/64-inch holes and tapping with 3/16 USS tap. Bolt the cleats in place with 3/16-inch stove bolts. The bent cleat attached to the fixed jaw of the clamp will always remain in the right position. Spreaders of this type are particularly useful on truck tires.

Fig. 3. Collodion, acetone, and alcohol mixed will clean celluloid

To Clean Celluloid

IN A year or two the celluloid windows in the curtain of an open car become fogged and scratched so that it is difficult to see through them. The usual remedy is to have new celluloid lights fitted, but it is often possible to restore a clear surface by treating with a preparation of one ounce of flexible collodion, one ounce of acetone, and two ounces of alcohol.

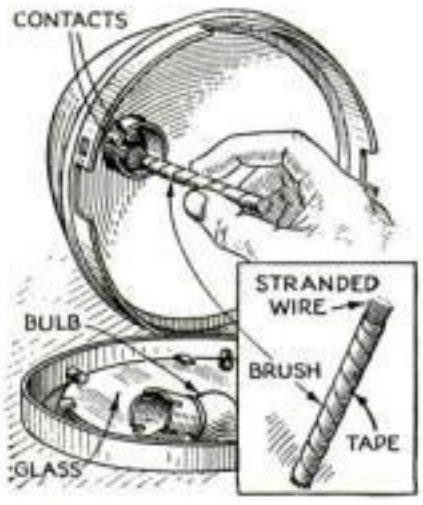


Fig. 4. A bundle of picture wire, taped together, forms a brush to clean lamp contacts

A Wire Brush

CLEANING contacts in lamp sockets is difficult. A tool that does the work easily is shown in Fig. 4. To make it, take several pieces of stiff picture wire and lay them side by side in a bundle. Tape tightly, leaving about 3/16 of an inch of wire exposed at one end.

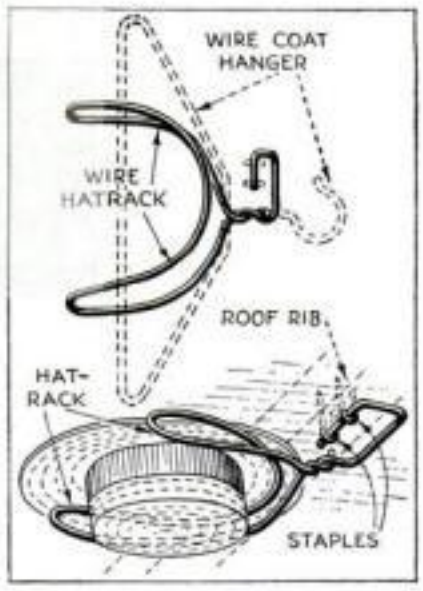


Fig. 6. Bend arms of coat hanger inward; staple to rib in top. This is a good hatrack

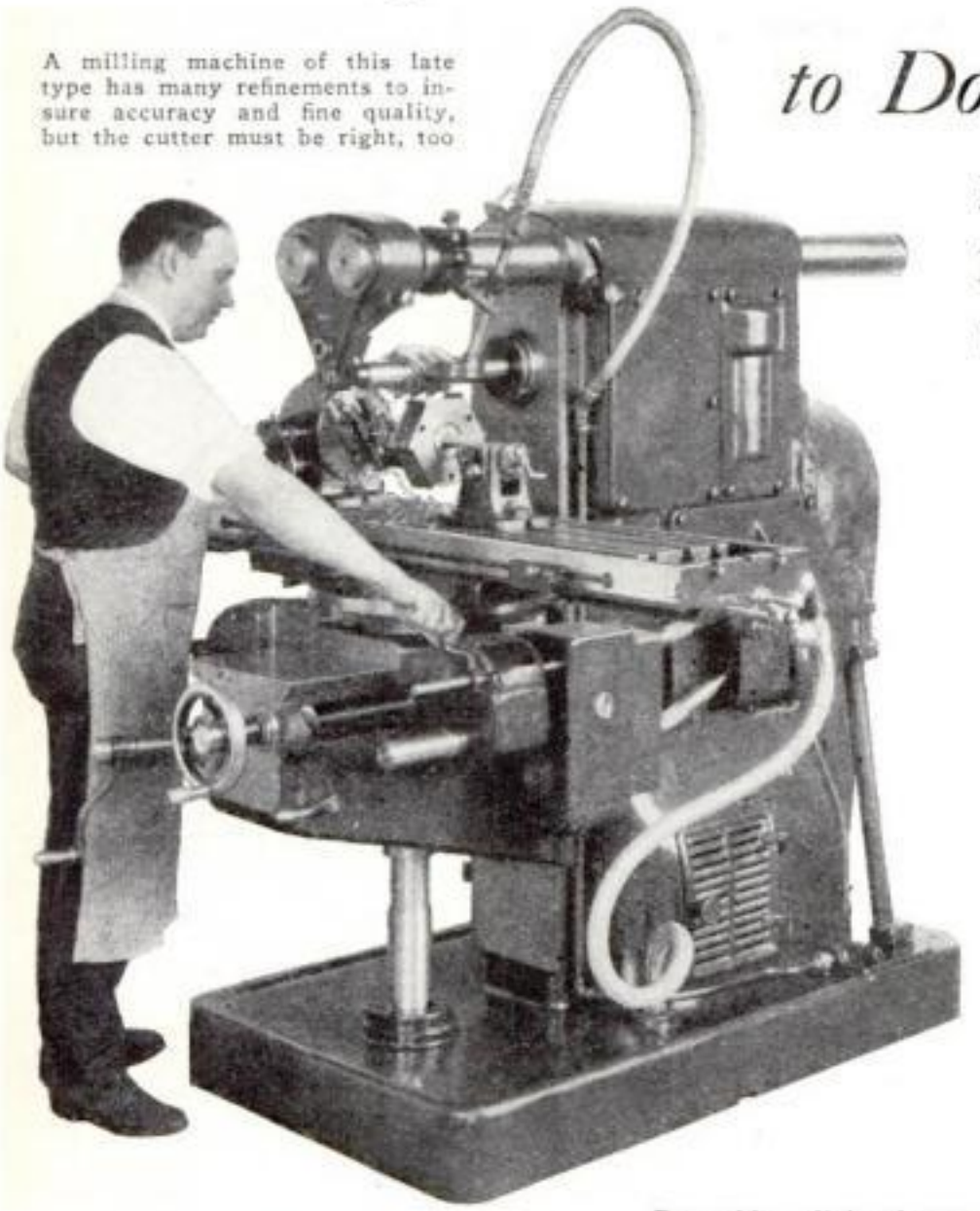
Simple Hatrack

MANY motorists find it more comfortable to drive in hot weather with their hats removed. This brings up the problem of what to do with the hat when the car holds a full complement of passengers. Figure 6 shows a simple hatrack that can be made out of the ordinary wire type of coat hanger. The straight cross wire is curved inward and the ends brought out to form a half circle. With the hoop bent as shown, a couple of staples will hold the hatrack securely to a rib in the top of the car. If it is more convenient, fasten the holder to the side of the car with the hoop pointing upward.

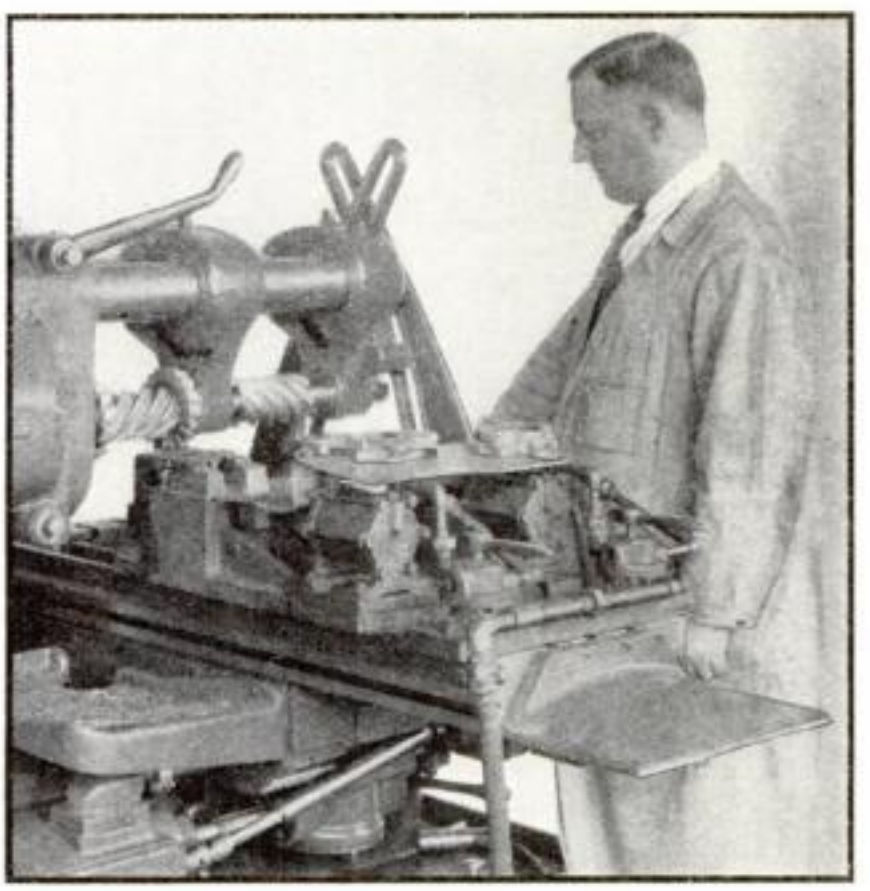
Coaxing OLD Milling Cutters *to Do the Work of* NEW

HINTS ON HOW HARD-PRESSED MACHINE SHOPS CAN KEEP DOWN THEIR TOOLING COSTS

By Hector J. Chamberland



A milling machine of this late type has many refinements to insure accuracy and fine quality, but the cutter must be right, too



By making slight changes on its regular tools, the small shop often can copy the methods of big plants and set up gang milling cutters to speed production

BECAUSE of the economical methods introduced in the average shop during the last two years, the tool box, to use a common shop expression, is traveling in all directions. The specialist and set-up man in many cases have made a forced exit. Only men familiar with several operations are to be found on the floor; yet the average all-round machinist and toolmaker, clever as he may be in every sense of the word, still lacks the special training his less fortunate buddy has obtained by doing the same kind of work for a number of years.

This lack of specialized experience is likely to be noticeable in operating the milling machine. It is quite true that the results of any milling operation are largely governed by the tools that do the cutting, but unless the machinist has a substantial knowledge of cutters and their upkeep, he is bound to drag on the job.

The average tool crib has a good supply of milling cutters, and in nearly every case something suitable for the work on hand can be found, even if the shapes and sizes have to be altered. As will be outlined later, it is surprising what can be accomplished with old cutting tools that have already paid for themselves several times.

The milling machine itself, on the average, is built very sturdily and will give many years of accurate service unless abused beyond reason. When not in use, the spindle belt should be off the pulley. By seeing to this and keeping the belt clean, there will always be good driving power, which is essential.

When you are ready to set up the machine, select an arbor of a size suitable for the work, clean out the spindle bore before you insert the shank, and check for accuracy as shown at *A* in the drawings on page 84. The least burr on either taper bearing will throw out the threaded end from .008 to .010 in. If this difficulty does not exist yet the arbor still runs out, it should be straightened in the lathe. Before doing this, however, see that the center holes are in good condition. These should be scraped if necessary. If the arbor is hardened all over, the neck and center of body should be heated with a torch; never attempt to do the straightening otherwise. Spotting the shoulder and barely touching up the shank on the cylindrical grinder will complete the preparation of the arbor; and if the collars are surfaced off, it will be like new.

It is important, too, that the overarm center and bushing be kept in good condition by proper lubrication.

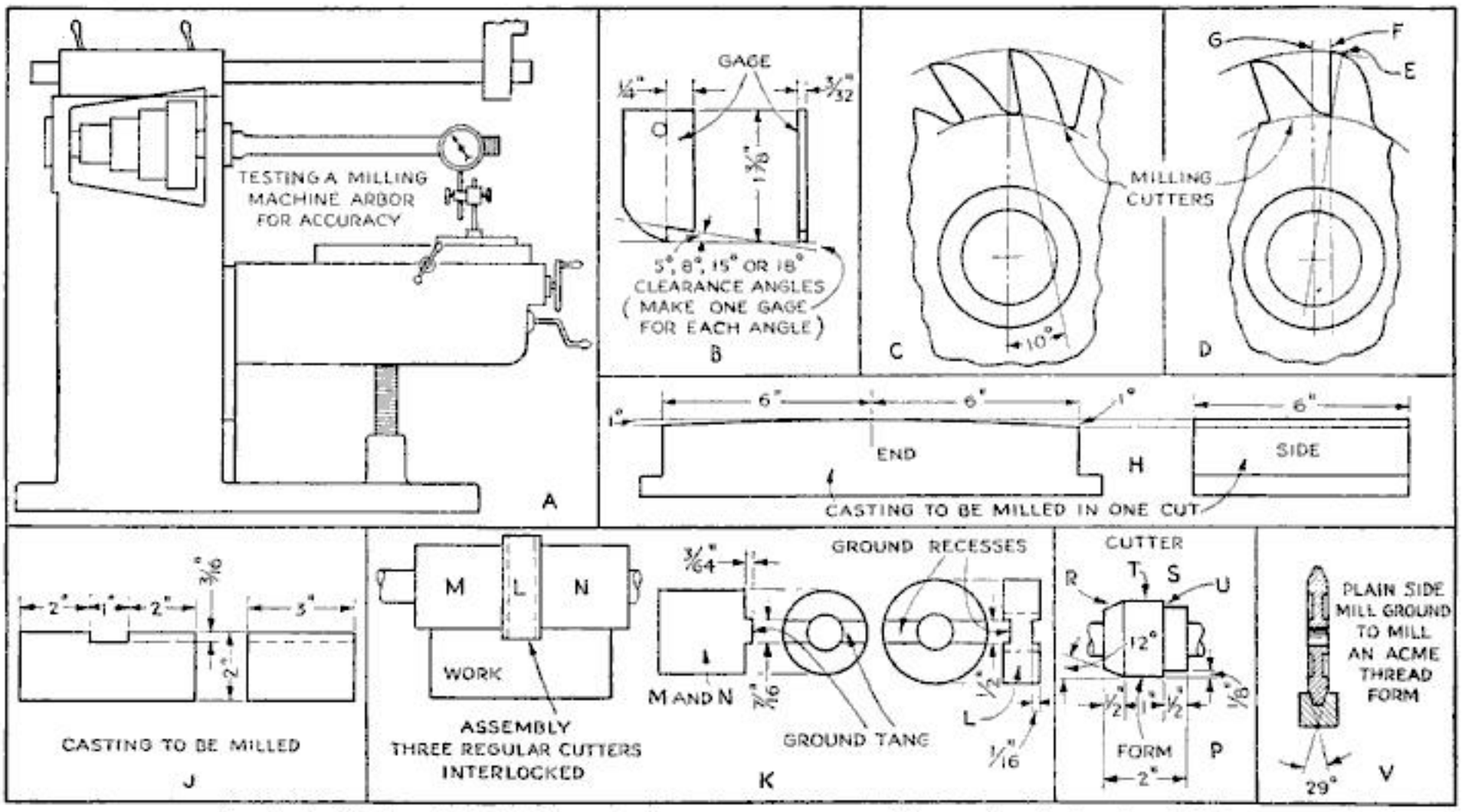
Once you have looked into these preparatory details, study your drawing to find out what cutters you need for the job. Get all your tools in one trip. Don't practice the comic sheet trick of chasing to the crib four or five times. Consult your machine shop handbook on feeds and speeds. Don't forget that the material to be machined makes a difference in this regard. Avoid overspeeding. An hour gained this way may mean a day's loss from a ruined cutter that must be junked.

All milling tools, to perform as they should, require a clearance angle suitable for the alloy they are to cut. The mechanic who is not familiar with the care of such tools will find the following suggestions helpful.

When grinding any cutter, always set the finger rest under the tooth to be ground. If no protractor is available to check the correct clearance, you should have some simple gages as shown at *B*. These are handier than protractors and may be made in a short time. A set of four is desirable, one each for 5, 8, 15, and 18 deg. For machine and tool steel, give the top teeth a 5-deg. clearance; for cast iron and soft metals, 8 deg.

More than 60 percent of cutters in common use have a 10-deg. undercut as indicated at *C*. In other words, the teeth are correspondingly milled back of the center line. In this connection note diagram *D*. The heel of the tooth, which is marked *E* for clearness, must be no higher than face *F* as it rotates to radial point *G*. A 10-deg. clearance is thus required to balance the undercut. Such small details as this one have caused inconvenience to many a good machinist and toolmaker.

The objective in the average shop today is to get along with whatever supply of tools is on hand. By using them up at such times as these, the owners will be



Sketches by Mr. Chamberland to illustrate points on cutter economy. His experience is that about half the work spoiled on millers in shops which have dropped their tool grinder hands is due to neglect of the cutters

in better position to replenish when conditions improve. Regular cutters therefore may be made up into gangs or turned into angular, concave, or convex forms, and except for high production they will fill the bill nine times out ten.

Suppose you were handed a job like that shown at *H* and the manager or foreman said: "Do the best you can. Fifty pieces are needed and we could make money on them if we only had a gang of cutters, but I guess we'll have to get along without them and use the shaper."

You could then suggest that one way out would be by making over some stock cutters. For the two surfaces, each 6 in. long and on an angle of 1 deg. which have to be milled in one operation, you could probably find two cutters of sufficient length, but it would perhaps not be practical to interfere with them. The best thing then would be to select three cutters for each side to get a combined face of about 6½ in. The first operation would be mounting the three on a gang arbor with the teeth in the same direction and grinding the angle on the cylindrical grinder. With a length of 6½ in., figuring on an included angle, and if the large diameter "mikes" exactly 3.000 in., the small diameter should measure 2.772 in. The other set of cutters should be mounted the reverse way; that is, if the former was "top coming," the latter should be "bottom coming." Of course, all respective diameters should be the same. This job should be done in one and a half hours.

If you had to mill a number of pieces as shown at *J* and wanted to gang three cutters that had no keyways, how would you proceed? In this case, you need a cutter with a 1-in. face and two with at least a 2⅛-in. face. After grinding the teeth and getting the required step, the next operation, as suggested at *K*, would be to cut a recess 1/16 in. deep and ½ in. wide on each side of cutter *L*. This is done on the surface grinder with a 6 by ⅛ in. elastic wheel, medium grade. The cut should be held as central as possible. Tangs 3/32 in. deep and 7/16 in. wide are cut the same way, one left and one right on cutters *M* and *N*. This trick takes less than half an hour.

There is such a thing as stepping and forming a single cutter to obtain a form as shown at *P*. For less than fifty pieces it will answer the purpose of a form cutter. The tool should have at least a 2¼-in. face; and the steeper the angle, the longer the teeth should be. The first operation would be to grind the cutter straight and then grind angle *R*. Face *S* is then finished to correct relative diameter until width *T* is obtained. This is done by setting the stop on the table. A sharp corner at *U* is easily retained by using a 6 by ⅛ in. medium grade elastic wheel.

Side mills usually can be made over to form included angles up to 25 and 30 deg. as suggested at *V*.

Other common problems in milling machine practice will be discussed by Mr. Chamberland in a following article.

DOUBLING THE LIFE OF SNAP GAGES

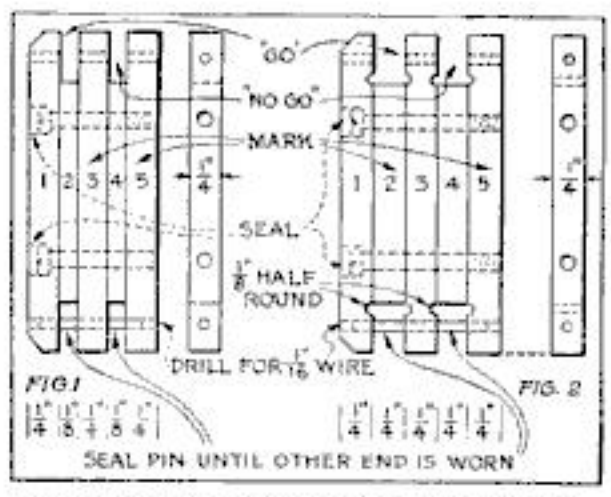
THE expense of snap gages is always high in any machine shop making a line of interchangeable parts. Their cost, however, may be cut materially by making them double-ended as illustrated in the drawing at the right. It is obvious that the double-end type will give twice the service before it becomes necessary to regrind them.

A 1/16-in. hole is drilled at each end of the gage as shown, and a wire is inserted at one end and sealed so that only the opposite end may be used. When the end first used is worn beyond the allowable limit, the pin is changed to the opposite end and again sealed to avoid any chance that an error will be made.

Gages for dimensions under ⅛ in. are made as in Fig. 1. In regrinding to size, from .003 to .005 in. is removed from the inside of the part marked No. 1, both sides of No. 3, and the inside of No. 5; parts Nos. 2 and 4, of course, do not need to be touched.

For dimensions over ⅛ in., the gages are made as in Fig. 2. From .003 to .005 in. is removed from each side of parts Nos. 2 and 4, and after the gage has been reassembled, the dimensions are finished in the usual manner. This is, indeed, the proper procedure for this type of gage; but often the required size is much under ⅛ in., and, since it is not safe to thin a medium grade grinding wheel to such a size, the method first described should be used.

In the latter case, if the dimensions are snug after assembling the parts, the gage



Twice the usual service can be obtained from double-end snap gages. Sizes under ⅛ in. are made as in Fig. 1; larger sizes as in Fig. 2

can be lapped, provided the grinding is true; and, with reasonable care, no trouble should be experienced in getting the correct size.—L. N. D.

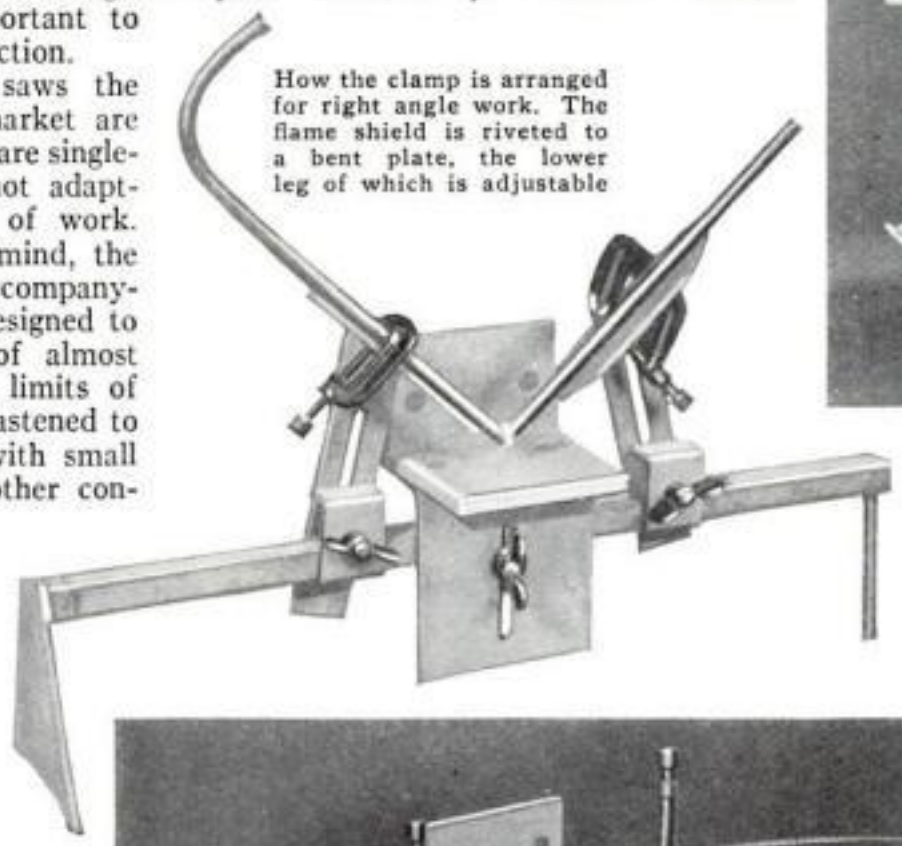
Easily Made Brazing Clamp Holds Work of Any Shape

ONE of the most troublesome details about brazing, or soft soldering for that matter, is holding the parts. When they are wired together, the heat often expands the wires enough to make them loose, or the brass flows over the wires so it is difficult to get a smooth job. Sometimes, indeed, the wires melt altogether just when it is most important to maintain a rigid connection.

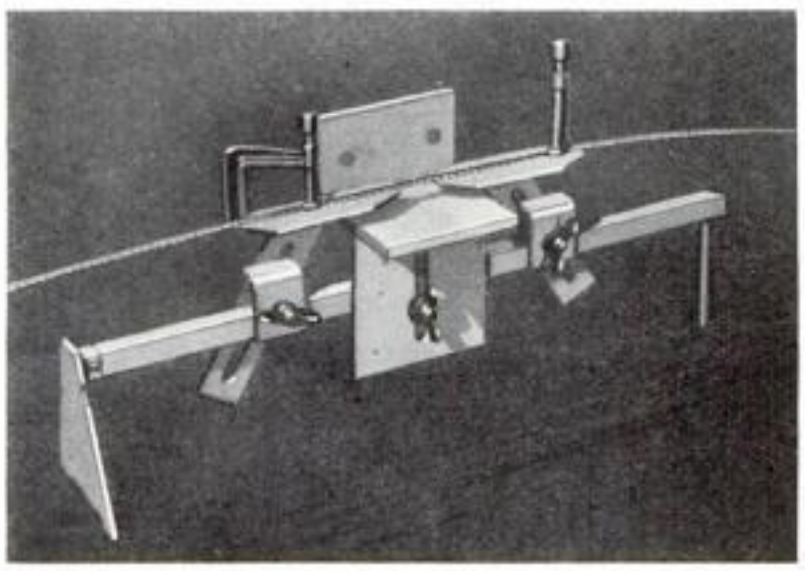
For brazing band saws the clamps now on the market are most efficient, but they are single-purpose devices and not adaptable to other classes of work. With these points in mind, the clamp shown in the accompanying illustrations was designed to accommodate a job of almost any shape within the limits of its size. The work is fastened to the supporting arms with small C-clamps or by any other convenient means, with the addition of V-blocks, if necessary, to conform to the shape of the pieces to be brazed. During the preparation of the joint, the flame shield may be dropped out of the way or removed entirely from the bed.

As the drawings show, the bed is made of a square bar with a triangular plate at one end and a single leg at the other to allow the device to stand firmly on an uneven surface. Supporting arms of the style suggested will probably prove the most useful, but for special jobs, other shapes may be made up, if necessary.

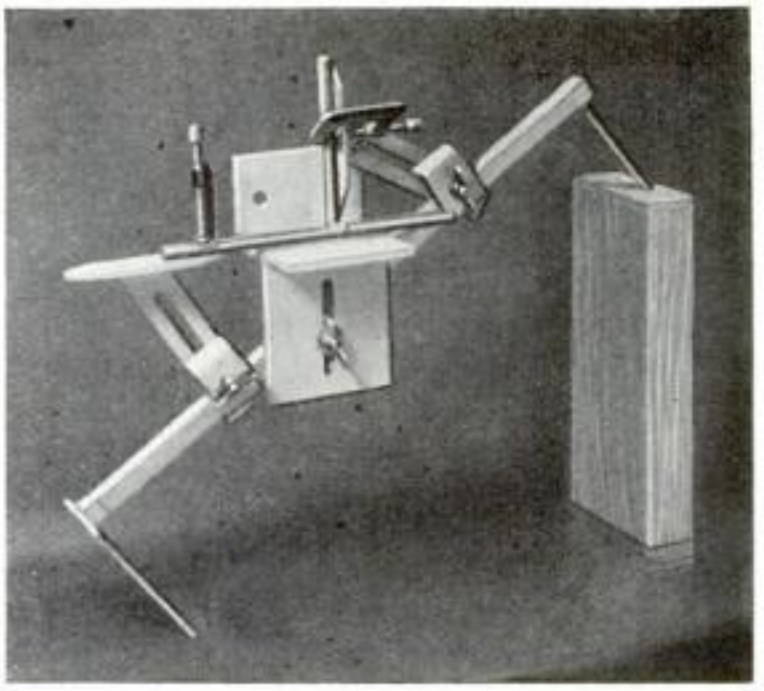
The clamping clips are shown with a drilled hole, but one of the three required should have this hole filed out square to take the head of the carriage bolt for the flame shield. The other two bolts are assembled with the heads against the slot, making a square hole unnecessary.—WARREN CRANE.



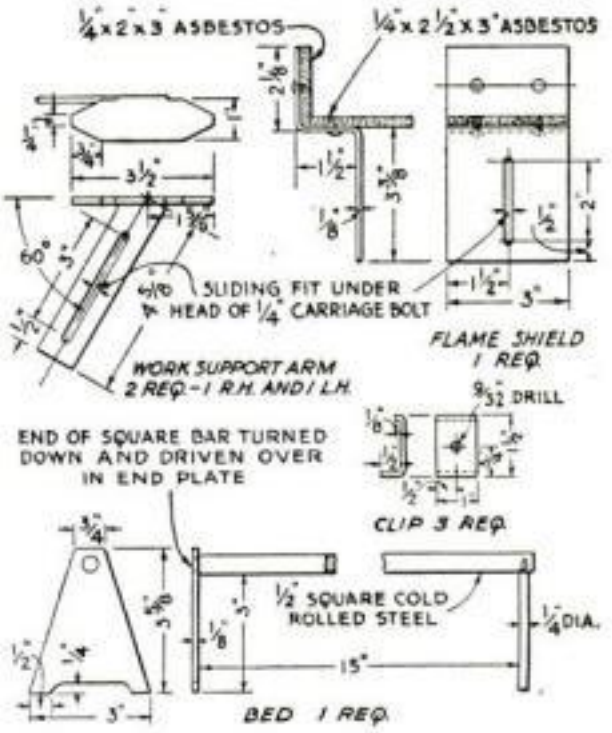
How the clamp is arranged for right angle work. The flame shield is riveted to a bent plate, the lower leg of which is adjustable



A more common type of job—brazing a band saw—is shown above, and the drawings of the parts appear at the right



A set-up for brazing a tee. The heat resisting material of the flame shield is of the asbestos board type. It is fastened with small rivets, so that it can be replaced when burned through. The metal parts are given a sand blast finish



Old Bill *Says* . . .

THE efficiency of a grinding wheel is governed by its surface speed; 6,000 surface feet per minute is considered normal.

An ordinary bearing or similar surface can be lapped in about one third the time it would take to scrape it.

In changing the location of a bored hole, a dial indicator will be found more accurate than the graduations on an old milling machine providing the requirements are within the range of the dial.

To obtain really accurate measurements, both work and gage should be at the same temperature.

If a number of pieces are to be machined in the miller and the nature of the work makes it impossible to use straps and bolts, it will often prove worthwhile to set up a magnetic chuck.

A discarded planer knife, with the cutting edge ground and lapped to a 1/32-in. flat, makes an excellent straightedge.

When cutting off steel for any tool that is to be hardened, allow an extra piece—a small one—for making a heat test. This precaution may cost a few cents more, but it often saves dollars.

IMPROVISING THREAD CALIPERS IN AN EMERGENCY

Two flat steel pieces clamped to the legs of ordinary calipers for measuring threads

WHEN work is at hand which requires the use of thread calipers, a pair of ordinary calipers can be made to serve the purpose, if necessary, by the method shown above. Cut two pieces of steel 1/16 by 5/8 by 2 in., and round one corner of each slightly. Grind down the metal so that this corner will be thin enough to reach the root of the thread. The pieces are then rigidly clamped to the two legs of the calipers.—THOMAS R. COOVER.

Homemade Miniature Camera

takes pictures on movie film

By WALTER C. GRIFFIN

How the camera is held (in circle); its size compared to an enlargement of one of its pictures (above); actual size photos (right)

THOUGH tiny, this watch-pocket camera designed by Ellsworth Craft, of Los Angeles, Calif., makes clear pictures, holds film for 100 exposures, and can be built at little or no expense.

Its construction should appeal particularly to those photographers who enjoy experimenting, and some of them probably can make the camera even more compact. In efficiency it is equivalent to a box camera and therefore is satisfactory for taking snapshots in bright sunlight. When once a photographer learns how convenient it is to have a camera of this type with him at all times, he is more likely to appreciate the value of owning a high-grade miniature camera.

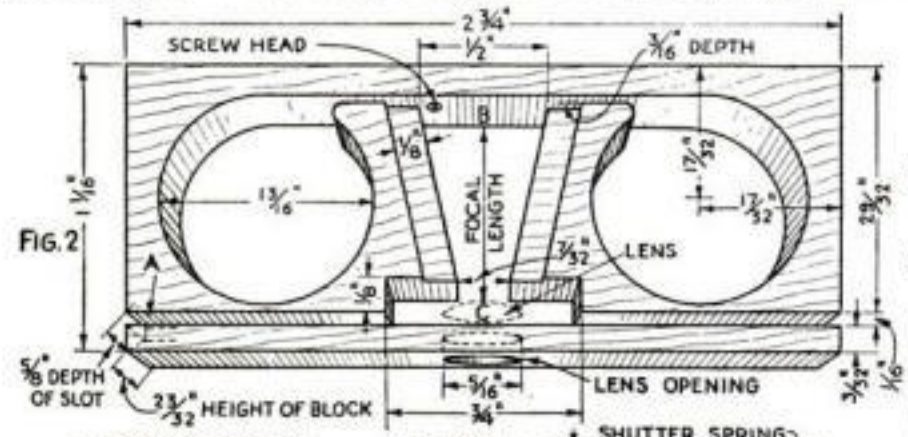
The lens is taken from the finder of a box camera of the No. 2 "Brownie" type. Hold it 10 ft. from a window and focus a sharp image of the window on a card. The distance from the face of the lens to the card is the focal length. Slip the lens into a countersunk block of wood as shown in Fig. 1 of the drawings, and over it place a brass diaphragm sheet drilled with a 1/16-in. hole.

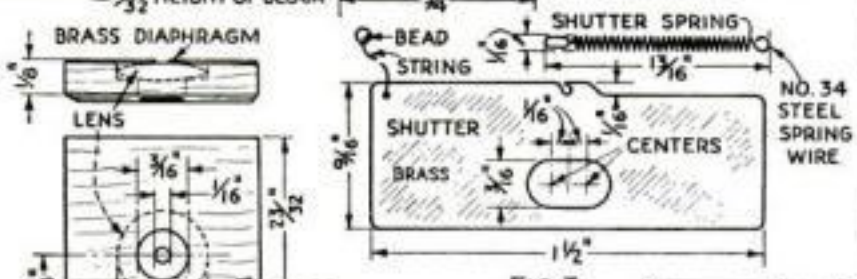
Cut out the camera form (Fig. 2) making the distance *BC* the same as the focal length of the lens. Cut slot *A* for the shutter, which is shown in Fig. 3. The spring hooks into the notch in the middle of the shutter. The film spool (Fig. 4) is a sixpenny nail filed down at one end and slit lengthwise as shown.

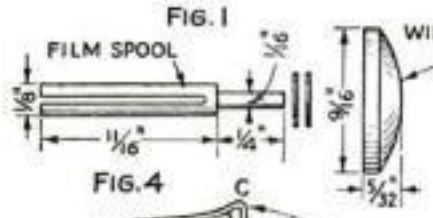
The finder (Fig. 5) consists of two pieces of aluminum joined into a hinge. Hole *B* is exactly opposite the center of the wire square *A*, which is picture size.

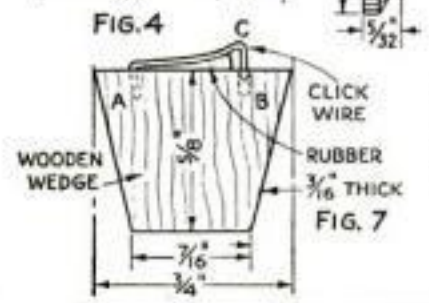
Into hole *A* of the wooden wedge shown in Fig. 7, force a spring wire. The other end should work loosely in hole *B*. A bit of rubber glued under the wire adds tension. When the film is wound, each sprocket hole makes hump *C* click against a screw head in the camera block. Three clicks advance the film one "frame" to the next picture.

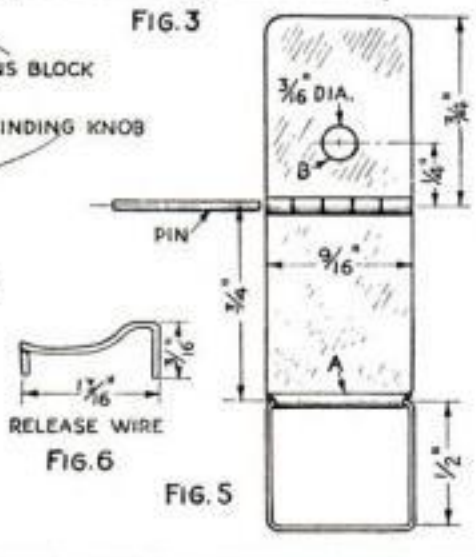
Slip the lens block (Fig. 1) into position in the camera form as shown at *A*, Fig. 8. Placing paper in the film slot, obtain an image of a window, and make sure the lens is in focus before gluing the block in. Next, at *B*, (Continued on page 99)

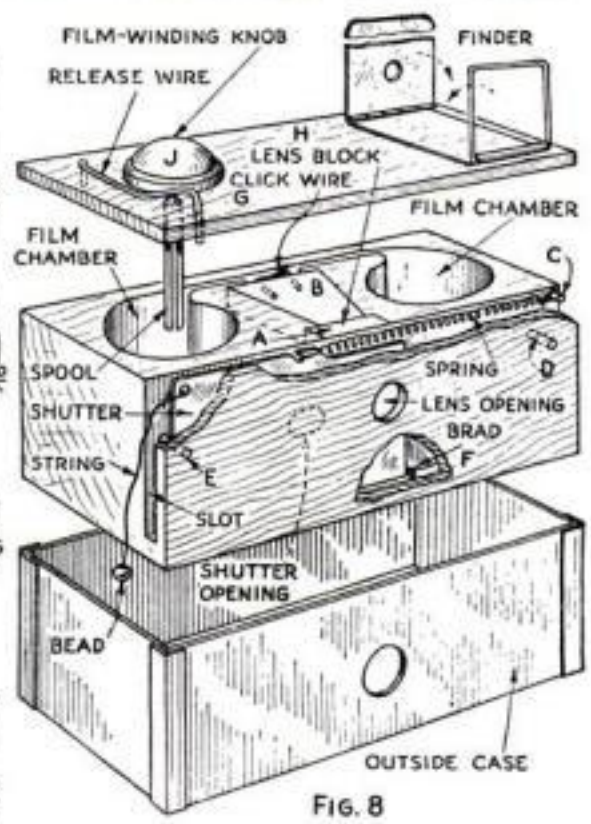


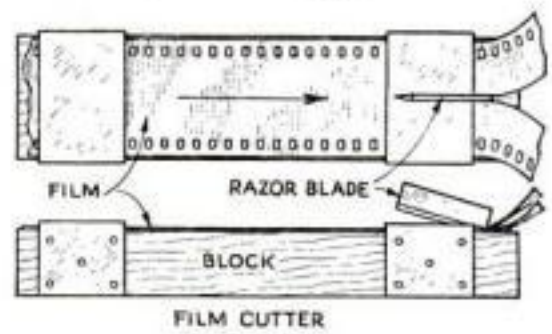












These drawings show the general principle of constructing the camera. Figure 8 is the main assembly view; Figs. 1 to 7 give the various details; Fig. 9 is a suggestion for making a cutter to slit standard movie film

How to Lay a WATERPROOF

Rubber Tile FLOOR

By *Everett Eames*

A hard felt base is first cemented on the old floor of the bathroom, and to this the rubber tiles are fastened. A border is necessary only if a diagonal pattern is desired

THE most serviceable floor obtainable is none too good for the bathroom. Artificial stone mosaic is the first choice of many home builders, but this is expensive and requires considerable experience to lay. Some may also object to the fact that it is cold. Rubber tile has neither of these objections and can easily be laid by anyone over a wood or linoleum covered floor. The only tools required are a linoleum knife, a straightedge, a rule, and an old table knife to spread the cement.

First carefully measure the space to be covered and order the tile through a linoleum dealer. It is a little more work to "diamond set" the tile as shown in the accompanying photographs because a border is required, but the cost is the same per square yard and the finished job is much more pleasing in appearance. The hard felt base and two kinds of cement, one for the base and one for the rubber, are usually included in the price of the tile. If a border is to be used, the rubber will be supplied in sheets to be cut up on the job. The tile itself comes in standard sizes of 4, 8, and 12 in. squares.

Lay the base in sufficient cement to hold it securely. To overcome any tendency to spring up, the base material should be beveled under slightly in cutting, but if it persists a few ½-in. brads along the edges will hold it.

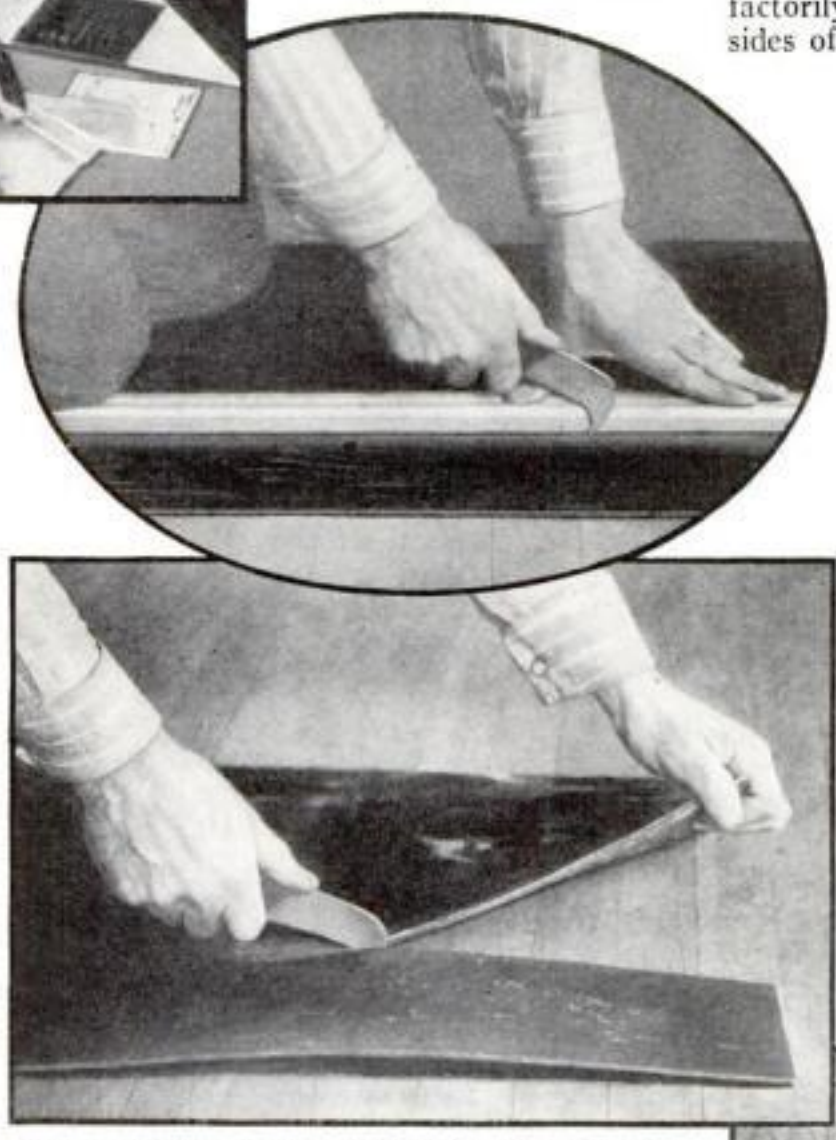
Place all the tile, including the border, without any cement at first. Make the border the same width as the tile if possible, otherwise divide opposite borders evenly. With the linoleum knife carefully score the rubber against a straightedge and finish cutting through as shown in the two central photographs. A suitable knife can be ground on an emery wheel from an old bread or paring knife, but a regular linoleum knife usually can be borrowed from the dealer.

In the trial set-up, leave rectangular openings around the porcelain fixtures. To fit tile in these spaces, first cut a number of paper squares exactly the same size as the tile and trim them to fit definite locations. Using these as templates, cut a corresponding number of tiles.

When the fitting has been done satisfactorily over the whole floor, cement two sides of the border in place with as little cement as possible. In setting each individual tile, lay it on the cement about ½ in. from its correct position and push it slowly into place. A small quantity of cement will thus be plowed up to remain between the butted edges of adjacent tiles.

After the laying has been completed, roll the surface heavily with a common rolling pin, applying as much pressure as possible. Place weights at various locations and allow the cement to set overnight, after which a fine luster can be given with applications of regular floor wax.

In the writer's case the rubber tile, felt base, and two kinds of cement cost five dollars a square yard. The manufacturer's service department also sketched in the exact location of each tile on a floor plan of the bathroom which I had drawn to a convenient scale.



In oval: Using a linoleum knife to score the sheet rubber from which the border strips are to be cut. *Above:* The second operation in cutting the border. *At right:* Rolling the tiles after they are cemented

CASH PAID *for* Good *Shipshape Home Ideas*

If you, like Everett Eames, are always devising ways to improve your house, you will find it profitable to follow his example and send in photographs and brief descriptions of the work you do. Payment is made upon acceptance for available material. If interested, send a large envelope, stamped and self-addressed, for our Manuscript Bulletin No. 9.

Three Baseball Bats and a Chopping Bowl Make Novel Stand

BASEBALL fans will find particular enjoyment in making this novel stand. A wooden chopping bowl forms the top, and each of its three legs is a small baseball bat. A stand of this kind can be built in an hour or two at a cost not much over $1.25. It is unusually sturdy, making it especially useful in a boy's room, recreation room, or den.

You can purchase the bowl from almost any hardware or house furnishings store, and the bats from the toy counter of a five-and-ten or department store. The bowl illustrated is 14 in. in diameter and cost 95 cents. The bats, 26 in. long, were 10 cents each.

Turn the bowl upside down and locate three equally spaced points on a line 2 in. from the edge. At these points drill holes to receive flat-headed wood screws 1¼ in. long. On the inside surface of the bowl, counterbore the holes with a ¼-in. bit so that the screw heads will be below the surface, leaving depressions that can be filled with a plastic wood composition to conceal the screws.

One inch from the large end of each bat and at right angles to the surface, drill a hole about 1 in. deep and of a diameter to suit the threaded portion of the wood screws you intend to use. Mount the bats temporarily by driving screws through the drilled holes in the bowl, but do not tighten them. Arrange the bats so that they cross at a point about midway between the ends. The small ends should form a triangle, the lower points of which are about 15 in. apart. Tie the legs temporarily in this position with cord or bind them with a strong rubber band, and set the table on the floor. Adjust the legs until the bowl is level, and at the crossing point drill holes through each leg into one of the others. These holes should be of a size to receive 1½- or 2-in. wood screws.

At the point where the three bats cross, they are screwed together

The stand is a handy catch-all for use in a boy's room, recreation room, smoking room, or den. At the left is shown how the bowl is fastened to the bats

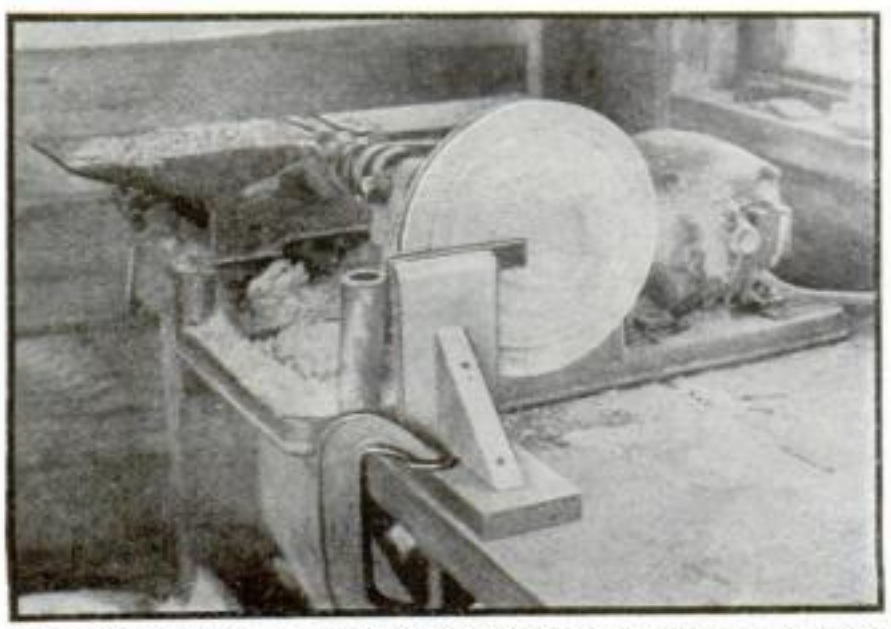
You can either use roundhead screws or counterbore the holes for flathead screws, later plugging the holes.

But before fastening the legs permanently, scrape or sand off the trade-marks, stain the wood to match the color of the top, and apply one coat of shellac and two coats of wax, well polished. The baseball bats used for the legs of the stand illustrated are of chestnut wood. The stain used to color them to match the maple bowl was prepared by adding some raw sienna to turpentine that had been darkened slightly with light-oak oil stain. Orange shellac was then applied, further darkening the wood. You will not have to finish the wood bowl because it already is coated with paraffin.—WALTER E. BURTON.

LARGE WORK TURNED ON SMALL LATHE

THE owner of a small combination woodworking outfit, which usually has a 6 or 8 in. swing lathe as one of its units, occasionally wants to turn a lamp base or some similar piece of work with a diameter greater than his lathe will accommodate. If the bed and tailstock are not permanently attached to the headstock, the oversize turning may be accomplished by making a tool rest of 1 by 3 in. stock, preferably oak, as shown in the illustration. This should have a bracing knee fastened with screws. The tool rest should be reenforced with ⅛ by 1 in. iron, let into the face of the upright wooden member and held by short screws. The end of the wood is beveled off toward the iron piece as indicated. In use, the tool rest is fixed to the bench with a heavy C-clamp after the bed and tailstock of the lathe have been removed.

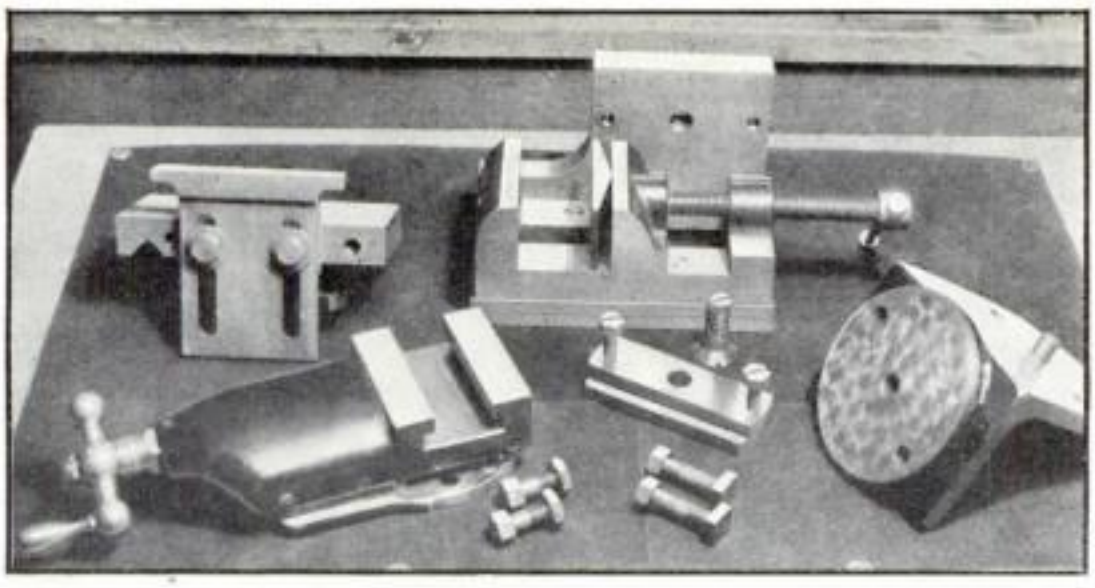
If a piece is to be turned with a radius greater than the distance from the lathe center to the bench, the lathe may be raised on blocks high enough to give the necessary swing. A higher tool rest will be necessary in this case. In turning these larger sized pieces, the speed of the lathe must be slowed down. —A. V. COMINGS.



A small woodworking machine with lathe bed and tailstock removed so that a lamp base can be turned with an improvised tool rest

NONTIPPING HOLDER FOR DRAWING INK BOTTLE

A 2¼-IN. GLASS cup or shoe of the type used under furniture legs and a bit of modeling clay or plaster of Paris will form an ink bottle stand heavy enough to prevent the bottle from tipping even when used on an inclined drawing board. Simply place the bottle in the center of the cup and press modeling clay around it, or pour in a mixture of plaster of Paris and water. This type of holder can be made in a few minutes and is even more satisfactory than one of wood, as the bottle will not work loose from the heavy glass stand.—ROBERT NEUBAUER.



By using special fixtures and a lathe compound slide, the work vise can be set up in a number of different ways to allow adjustment in three directions

Homemade Fixtures for HOLDING WORK TO BE MILLED IN A Small Lathe

By
HOLT CONDON

IN A PREVIOUS article in this series (P. S. M., May '32, p. 104) certain homemade milling tools for use on the lathe were described. With these it is necessary to have various attachments for holding the work rigidly and furnishing the means of feeding the work to the cutter.

Two set-ups are illustrated. Adjustment or feed is provided in three directions: laterally, through the carriage travel upon the lathe ways; transversely, by the cross slide; and vertically, by means of the lathe compound slide superimposed on a special angle plate bolted to the saddle of the machine. Still other positions are possible by swiveling the angle plate on its base and by pivoting the compound slide on the supporting angle plate.

The work vise may be attached in a variety of ways, two of which are illustrated. In the end-milling job it is set edge up by means of a base plate. In the cutting-off operation it is mounted flat through the agency of a second angle plate, which corresponds to a milling machine platen or worktable. Overhang of the work beyond the support on the lathe carriage proved a serious problem until an adjustable support was made to take the heavy strains incident to this type of work.

In designing these tools the writer was influenced by materials at hand and facilities available.

The angle plate used for mounting the compound slide was worked up in the vise with saw and files from a section of heavy structural angle iron. A turned base and reënforcing web were welded in place; and the base, distorted in the welding process, had then to be carefully scraped to a perfect bearing on the lathe saddle. It would generally be preferable to make a pattern and get a casting, as weight in this case is an advantage.

The base of the angle plate was drilled for the pivot and for two extra long 5/16-in. clamping screws which had to be made up with square heads. These screws and the standard S.A.E. nuts are case-hardened.

After the vertical face of the plate had been milled square with the base, it was bolted in position and set at 90 deg. to the lathe ways with the aid of an indicator clamped to the spindle nose. This commonly used position was marked on the base for reference. Holes were drilled in the face for a stud and clamping screws—5/16-in. U.S.S. hardened screws used in combination with thin nuts.

A cast-iron block milled to fill the compound T-slot completely distributes the load over the largest possible surface and supports the vise through a centrally located ½-in./13 flathead machine screw with slotted end. In addition, two ¼-in. cap screws secure the angular position.

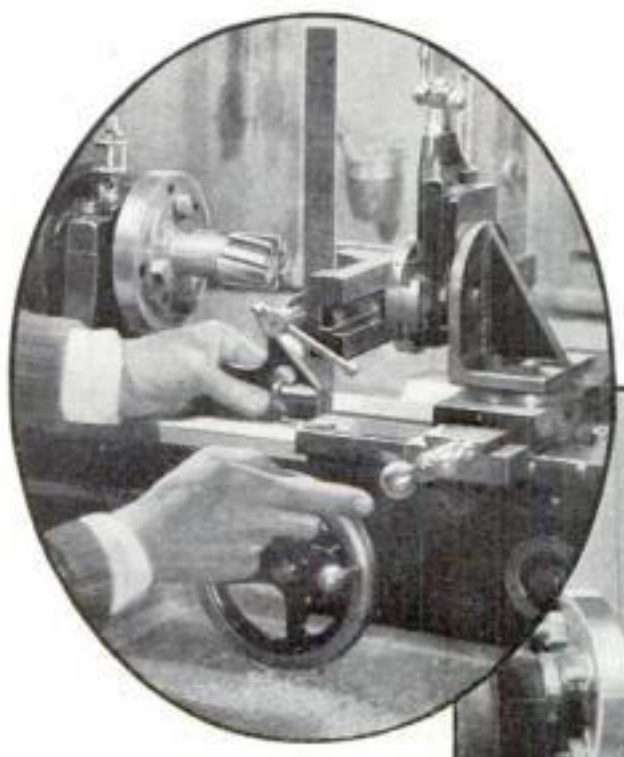
The angle plate used as a base for the vise is finished all over—a shaper job which had to be done outside. This makes it generally useful for other set-ups.

Spring in the system, with resulting chatter and danger to the rather lightly constructed carriage, pointed to the need of an additional support or rest. The construction of this fixture is clearly illustrated in the group photograph, and its application is obvious. The top edge of the adjustable member is fitted with a brass shoe along which the vise or supporting angle plate is fed, the load being transferred directly to the lathe bed. The block forming its base is used in other fixtures requiring attachment to the lathe bed. A steady rest for turning and a tool rest for woodworking are two of these.

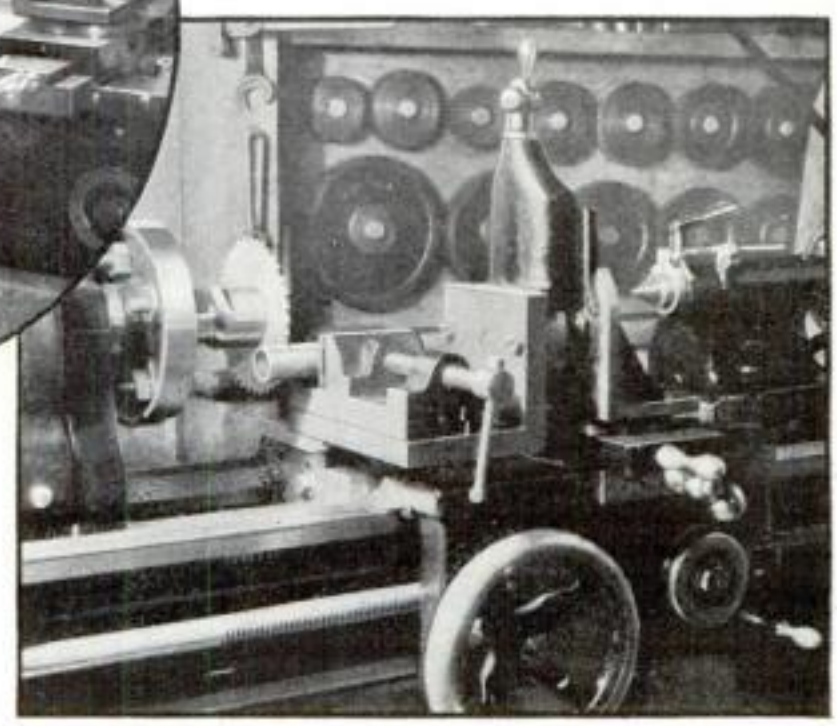
Jobs of fluting and simple indexing have been set up with the tools described, supplemented by improvised work centers. While such work could perhaps be better set up on the lathe centers with cutters mounted offside on an independently driven spindle, such an arrangement would involve more tools not yet attempted in this home workshop.

MAKING TIGHT JOINTS IN WOODEN TRAYS

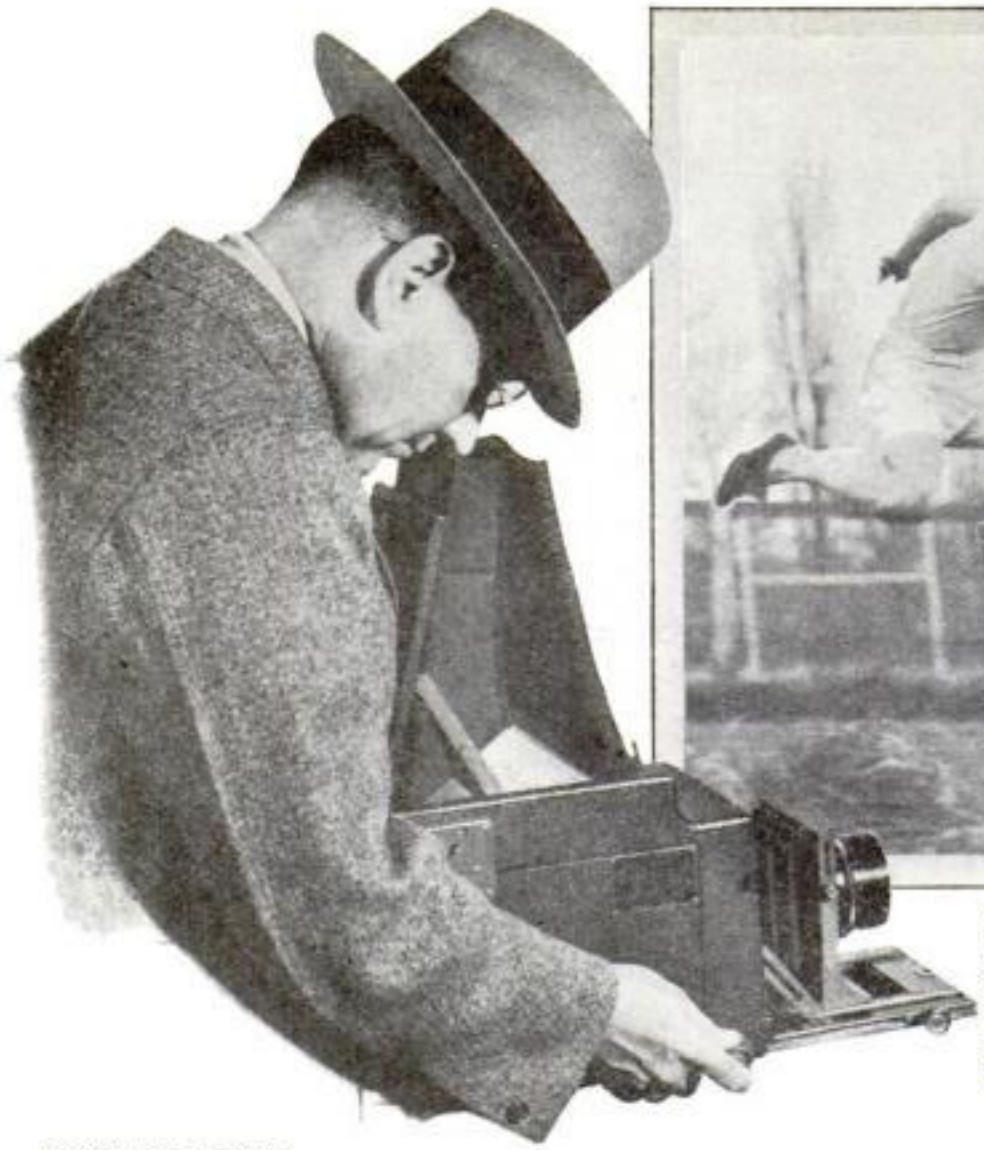
JOINTS in wooden trays or tanks can be made water-tight through the use of battery sealing compound. When building the tray or tank simply spread the melted compound evenly along the joints and then fasten with screws or nails as desired. After the piece has been completed, a little additional heat will partially remelt the compound and cause it to flow into every crack and opening, making the joints absolutely water-tight.—L. B. ROBBINS.

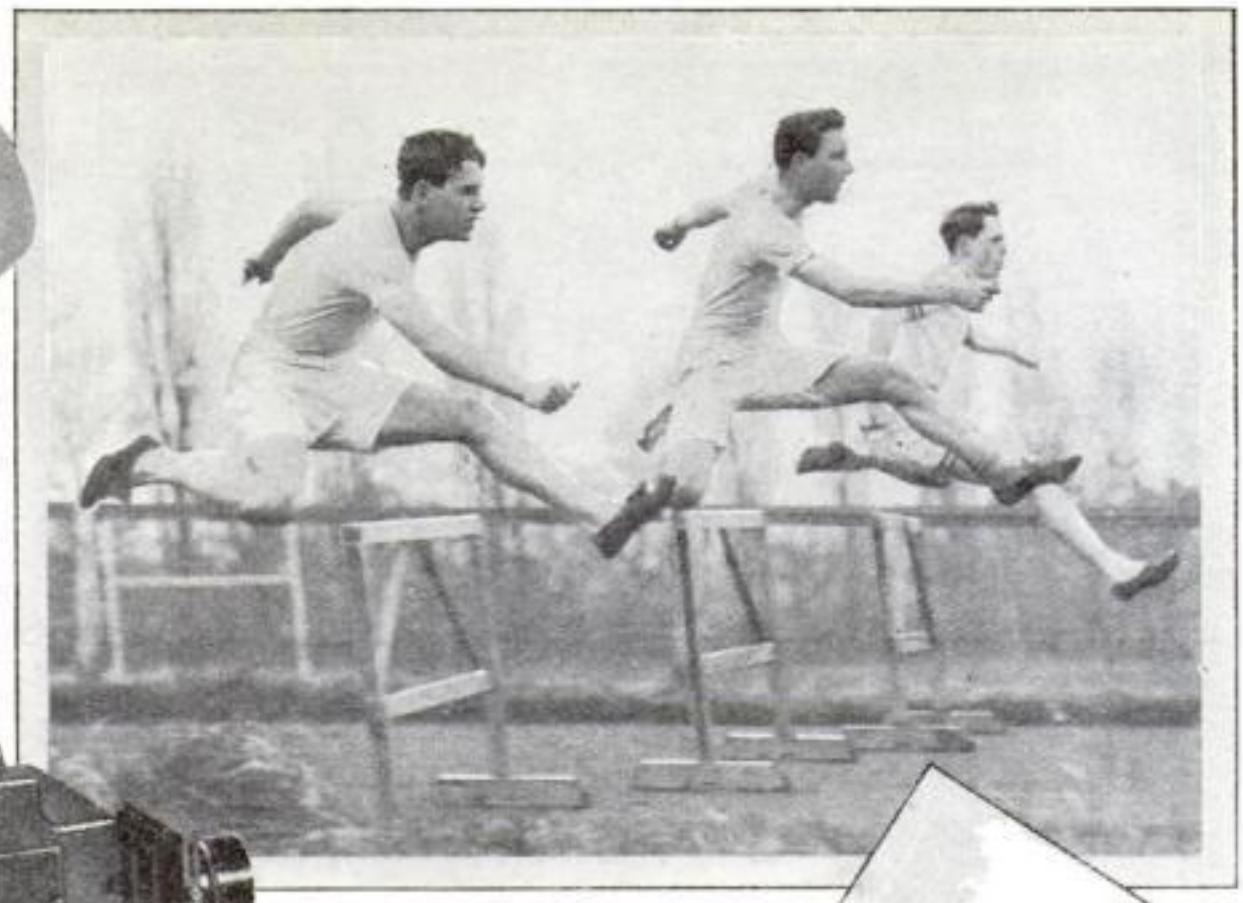


When using the end mill, the work vise is bolted edge up by means of a base plate as in the illustration above



In cutting-off operations, the vise is mounted flat on a second angle plate. An adjustable support transfers the load directly to the bed of the lathe





Cameras of the graflex type, like that shown at the left, have a high-speed shutter designed for sporting events and other action shots

WHAT YOU SHOULD KNOW ABOUT

Snapping Action Photos

Frederick D. Ryder, Jr., *explains the operation and advantages of a focal plane shutter*

ONE day last summer an acquaintance of mine thrust a fistful of prints in my hand and dangled a camera before my eyes.

"Look at 'em!" he said. "Every one so fuzzy you can't even recognize their faces. What's the matter with my camera?"

This man is the proud father of a boy who is making quite a reputation for himself in school athletic circles. He had bought the camera to use at the various meets in which his son competes.

"That one," he added as I looked at the top print, "is Joe finishing the hundred-yard dash, but you'd never know it unless I told you. I can't understand it. I set the shutter for a hundredth of a second and surely that ought to be fast enough to catch a runner without all that blur. Do you think the shutter is defective?"

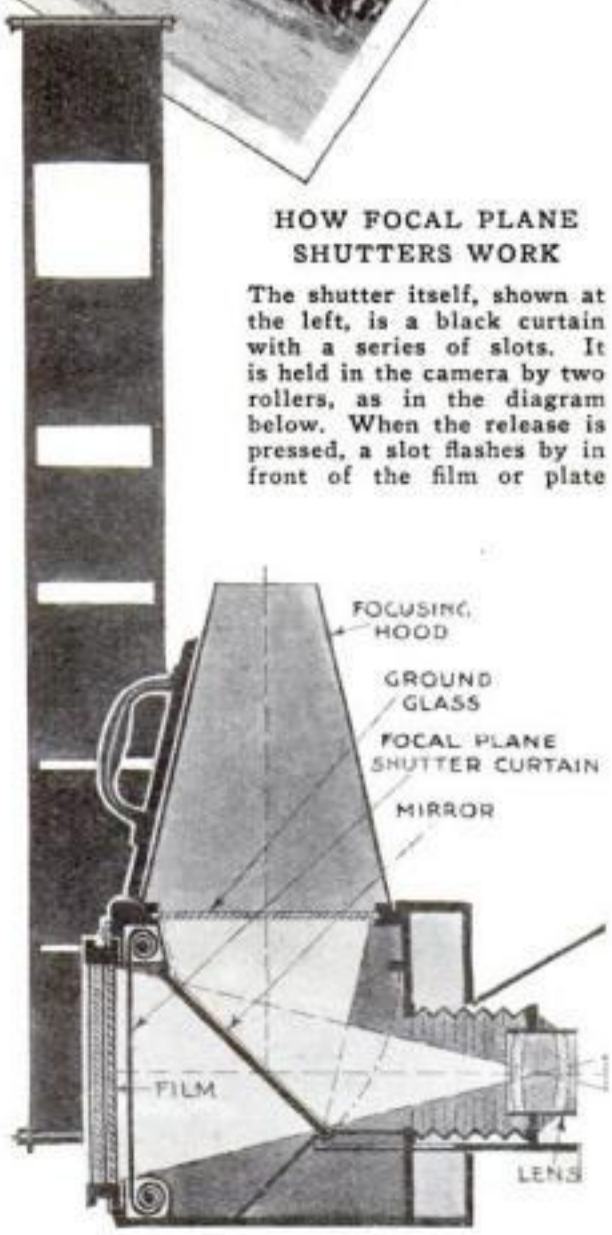
"I suppose Joe can do the hundred in not far from ten seconds," I said. "That means he moves nearly four inches during a hundredth of a second. If he moves that far while the shutter is open, how can you expect to get a sharp, clear picture?"

"Gosh!" he exclaimed. "I never stopped to figure it out that way."

He didn't realize that taking pictures of athletic events, or any other "shot" at a rapidly moving object, requires special equipment. The ordinary folding camera won't do. Its shutter is not fast enough. And, except in the higher priced folding cameras, the lens is not fast enough even if it were practical to speed up the "between-the-lens" shutter.

What speed really means in a lens was explained in a previous article (P. S. M., May '32, p. 78). The operation of ordinary types of camera shutters also has been considered (P. S. M., June '32, p. 90). In the better grades of such shutters the leaves, urged by the force of a spring, swing around pivots far enough to open a hole at least as large as the maximum working opening of the lens. Then they are stopped and moved back to the closed position to terminate the exposure.

It takes a measurable amount of time to force the leaves to go through this back-and-forth motion, so that a goodly portion of the exposure actually is made while the *(Continued on page 94)*

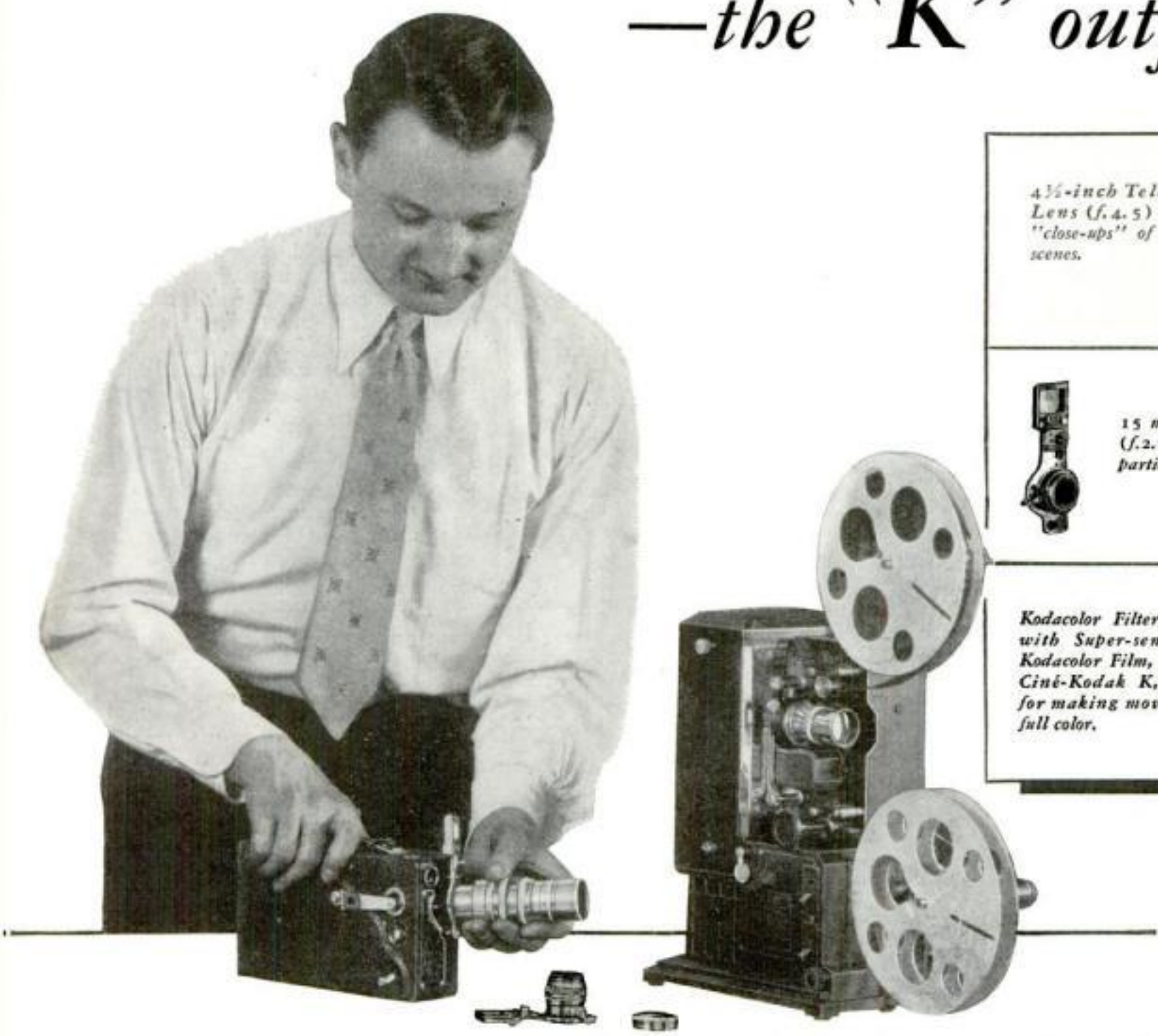


HOW FOCAL PLANE SHUTTERS WORK

The shutter itself, shown at the left, is a black curtain with a series of slots. It is held in the camera by two rollers, as in the diagram below. When the release is pressed, a slot flashes by in front of the film or plate

For the full range of home movies

—*the "K" outfit*



4½-inch Telephoto Lens (f.4.5) makes "close-ups" of distant scenes.

15 mm. Wide Angle Lens (f.2.7) takes in a wide view; particularly useful indoors.

Kodacolor Filter, used with Super-sensitive Kodacolor Film, equips Ciné-Kodak K, f.1.9, for making movies in full color.

HERE'S the newest and most interesting hobby. Movie making.

You can be director, cameraman, film editor, title artist, projector operator—all yourself. And in your fun from day to day you'll be assembling a collection of films that will constantly grow in value to you as the years fade into memory.

MODEL K Ciné-Kodak takes lenses and filters that allow you to grab every picture opportunity—indoors or out, day or night, and in color. Its *f*.1.9 lens is so fast that it gets clear, detailed pictures without bright light, and the addition of the Kodacolor Filter makes it ready for full-color movies that are strikingly true to nature. The wide angle lens is for greater picture area. The telephoto is for "close-ups" of distant scenes. And this camera has a half-speed for doubling the exposure (as in rain) and for interesting tricks.

MODEL K Kodascope is the quiet, smooth projector that does full justice to your Ciné-Kodak movies by giving them theatre-like brilliance on your home screen. A special optical system, efficient cooling, and rapid rewind are only a few of its important features. Addition of the Kodacolor Unit quickly fits it for showing color movies.

Get posted on movie making now. Visit your Ciné-Kodak dealer today. He will gladly show you the "K" equipment and some typical amateur movies.

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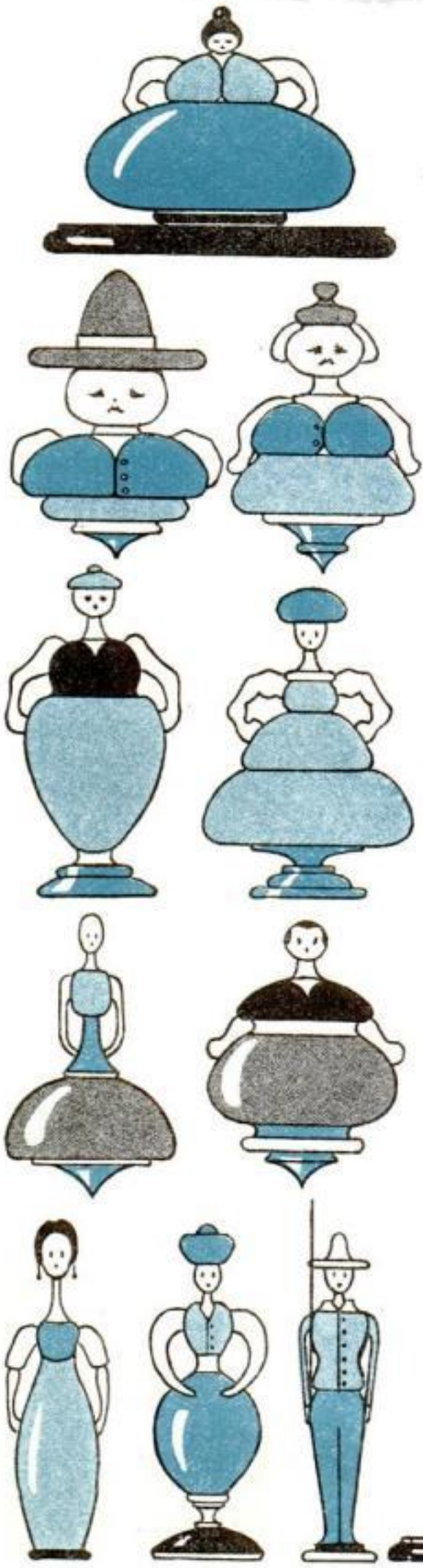
Ciné-Kodak *Simplest of Home Movie Cameras*

By
Harvey C.
Frederick

Amusing Designs for Turned Toys *and* NOVELTIES



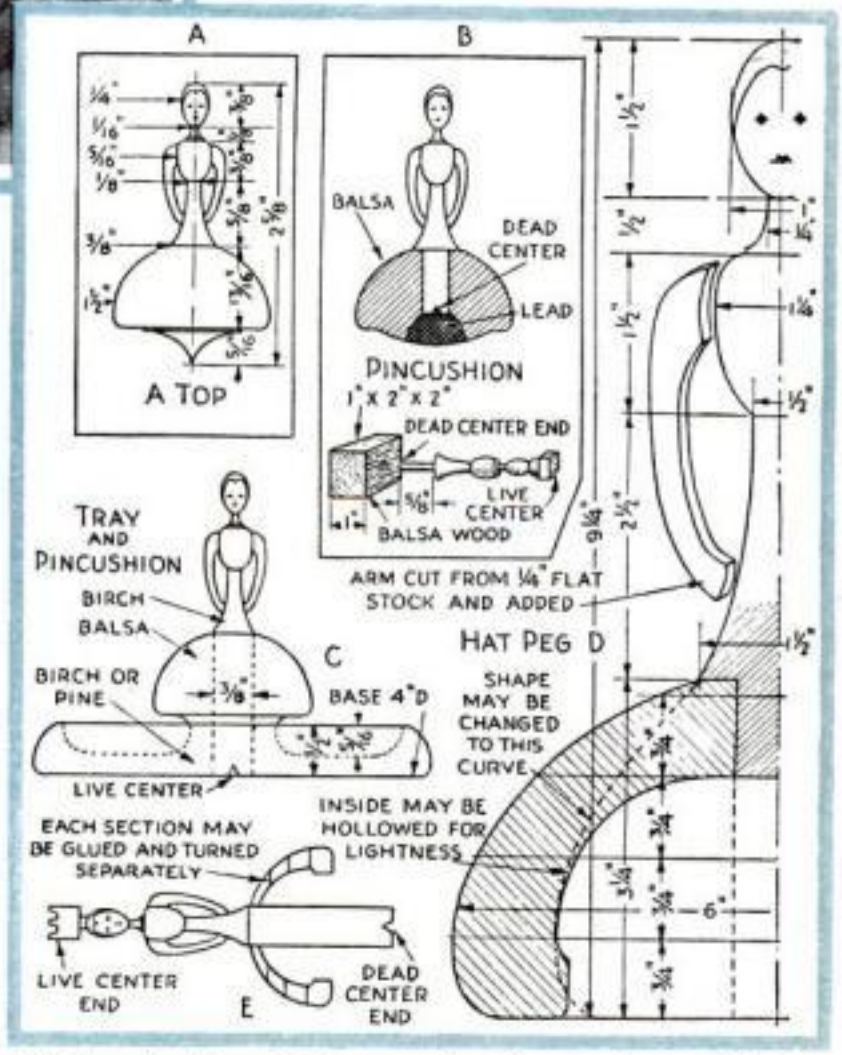
A hat stand and, above, a tray with pincushion of balsa wood

TURNING small toys and novelties on the lathe is an absorbing line of work for home craftsmen.

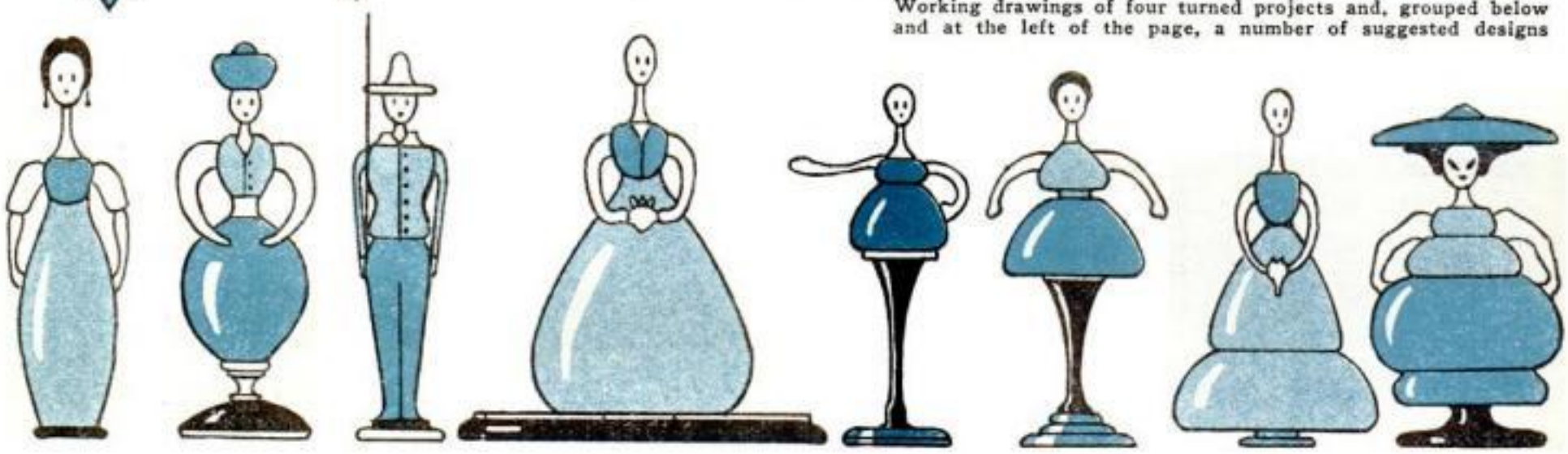
Where the parts are not especially small or fragile and when the finish is to be paint or lacquer, soft and smooth grained woods may be used, such as white pine, gum, or red cedar. Where greater strength is desired, white birch or any of the maples or other woods of this type should be chosen.

The Top. This is a practical little toy turned from birch or maple as shown at *A*. The arms are shaped from thin, flat stock and glued in place. The finish may be enamel or lacquer in pastel shades such as pale flesh or orange color combined with white, orchid, lavender, or blue. The eyes and hair are black.

The Pincushion. If balsa wood can be obtained, this makes a novel problem. The balsa, being too soft and light to support itself in the lathe, must be handled as shown in the sketch at the bottom of *B*. When glued on the stem of the other wood and turned with an extra sharp skew chisel, the balsa will have a finished surface not unlike pine. It is soft enough to allow pins and needles to be stuck into it. The finish may be the same as the top except that black or other very dark water

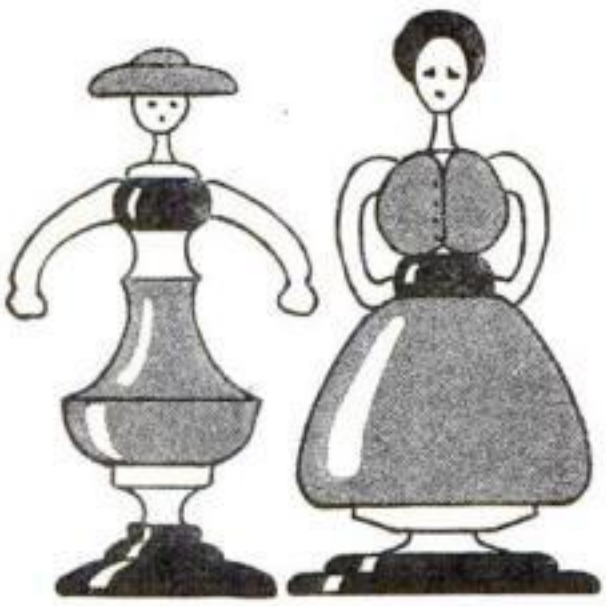


Working drawings of four turned projects and, grouped below and at the left of the page, a number of suggested designs



stain or dye should be used on the balsa to give a rich effect and to prevent the surface from becoming visibly marred with the pin pricks. The lead in the base may be poured into place when hot, and sandpapered round and smooth.

The Tray and Cushion. This involves the same problem as the pincushion just described except that a tray is added. It is suggested that the ⅜-in. stem be left long enough to extend through the base as at *C*. When the balsa wood and the stock for making the tray are glued in place, the body should be reversed in the lathe so that the tray is at the live center. If care is used in placing the work in the lathe in the reversed position, it will be found pretty well centered in the new

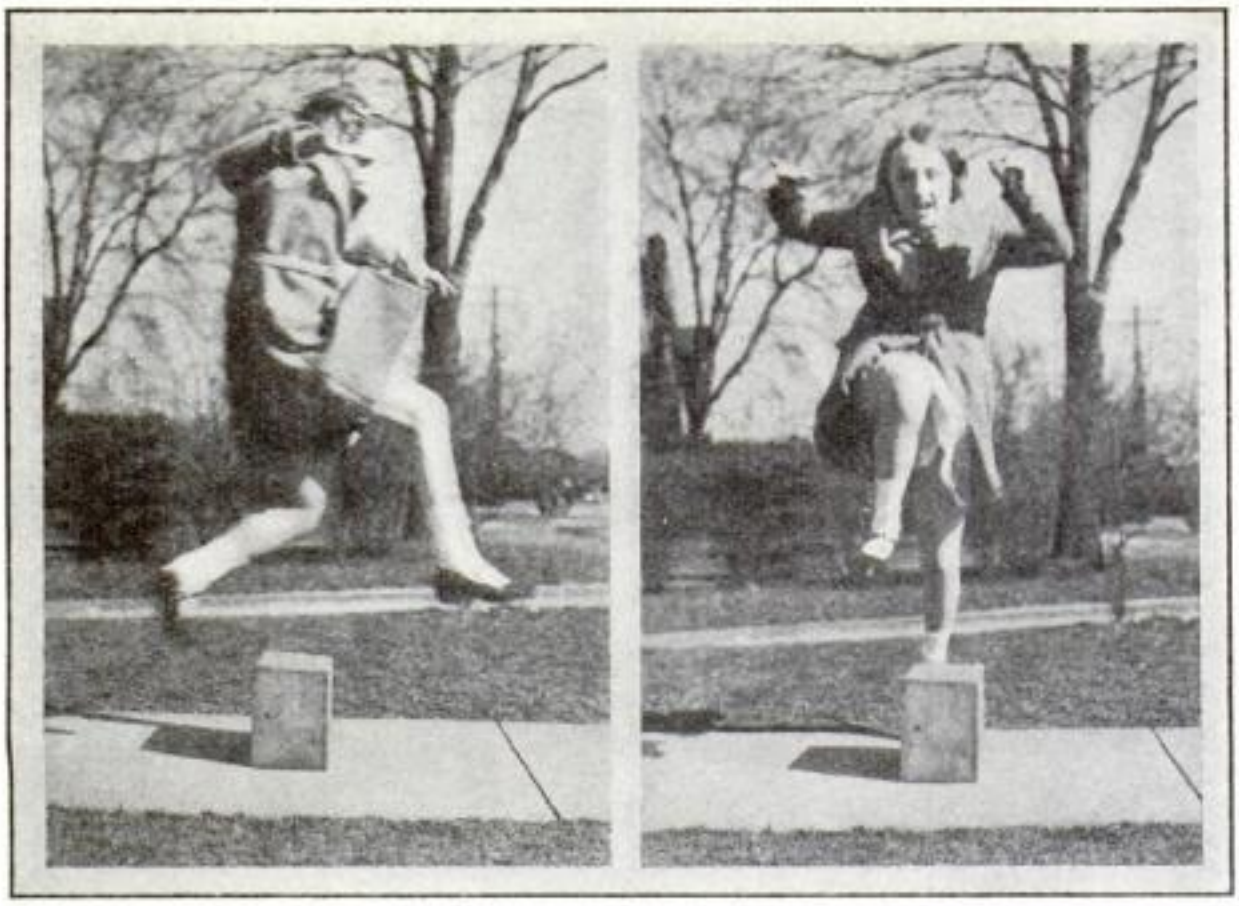


Another humorous couple. An ingenious wood turner can use these figures in various ways

position. As a safety measure it is best to leave the body as a blank cylinder until the base or tray is turned to the desired dimensions and sanded.

The Hat Peg. White pine or any of the light soft woods may be used for this piece as shown at *D*. Turn the body first and add the built-up stock for the base. The base might be turned separately as a bowl, the work being done in the form of a faceplate job, if desired. Another plan is to allow the center stem to extend through to the bottom of the base and add sections of ¾-in. stock as sketched at *E*. Each of these sections may be turned in order as it is added; this avoids the necessity of any faceplate work.

This is the top shown fully dimensioned at *A* in the working drawings on the preceding page



Two views of the same figure taken with a folding camera at two-hundredths of a second. Note box is sharper than the figure and also that head-on view is sharper than side view

Snapping Action Pictures

(Continued from page 90)

leaves are only partly open or partly closed. Because of this mechanical limitation, it has not been found practical to work such shutters, except in the smallest sizes, faster than approximately a two-hundredth of a second.

In order to stop the action of a fast runner, a horse jumping, autos racing, and so on, a little figuring will show that the exposure cannot be much over a thousandth part of a second if you want satisfactorily clear pictures.

The only shutter that will give such brief exposures, and do it in such a way that the maximum light-collecting power of the lens is utilized for the entire time available, is the so-called focal plane shutter.

This shutter consists of a curtain made of black fabric with a horizontal slot in it called the aperture. The curtain is held in position just in front of the film or plate by two rollers, one just above, and the other just below, the face of the film. When the release is pressed, a spring applied to the lower roller winds the curtain from the top to the bottom roller. The aperture, passing the film, allows light from the lens to affect the sensitive material. The length of the exposure is controlled by the size of the aperture and the tension of the roller spring.

IT WOULD seem a simple job to build such a mechanism, but it isn't as easy as it looks. To begin with, no ordinary black cloth will do. The material has to be light, strong, durable, and absolutely light-tight. A specially woven and specially processed cloth is used. Then the roller and spring mechanism must be carefully designed and constructed so that the aperture will move across the film at a uniform speed.

There are two ways to vary the width of the aperture. In most cameras built abroad, there is a single aperture, and the width of this slot is changed as desired by means of a tape mechanism. In this country, focal plane shutter curtains are made considerably longer with several fixed apertures of different sizes, any one of which can be brought into use merely by rolling back the curtain.

Tremendously fast shutter speeds make it necessary to use the lens nearly wide open with the stop setting placed at F/4.5 or F/5.6. Lenses of focal length suitable for use on hand cameras allow little leeway in focusing when used at these large stops. You may have a focal plane shutter and a lens fast enough to permit its use at top speed, but there won't be much satisfaction in stopping the motion if most of your pictures are fuzzy from inaccurate focusing.

Furthermore, most action pictures are taken on the spur of the moment. There is no time to waste in guessing the distance and in setting the focusing scale on the camera.

The best solution of the problem of quick and accurate focusing is the reflecting mirror mechanism. It permits you to focus the image on the ground glass and keep it in focus up to the instant of exposure. The mirror is set at an angle of forty-five degrees between the lens and the film as is shown in the diagram at the bottom of page 90. The image formed by the lens is reflected upward from this mirror to a ground glass set in the top of the camera. The mirror also inverts the image so that you see it right side up instead of upside down as you do on the conventional ground glass of the ordinary camera.

When you press the release, a spring swings the mirror upward where it is brought to a cushioned stop by the air trapped between it and the upper ground glass. Near the end of its upward swing, at the point where it gets out of the way of the image formed by the lens, the mirror trips the shutter, and the curtain aperture speeds across in front of the film.

Many people have the idea that the reflecting mirror, focal plane shutter camera is a special purpose instrument useful only for sport and action pictures. Its field is by no means so limited. The features that make it indispensable for speed work also are extremely valuable for any kind of snapshot picture anyone could wish to take. Focal plane shutter speeds usually can be adjusted virtually to any desired value from a tenth of a second up to a thousandth of a second. The slower speeds, with the lens wide open, for example, are ideal for "shots" of the baby when the light is poor. About the only photographic job the reflecting mirror, focal plane shutter outfit cannot do is wide-angle work. The mirror mechanism takes up so much room that the short focus lenses needed to get a widespread view of such subjects as architectural interiors cannot be brought near enough to the film.

When you first begin to take sport pictures with the graflex type camera, you are quite likely to get photographs that are distinctly out of focus. If you do, don't blame the camera. When the beginner looks down at the brightly lighted image in full colors formed on the ground glass, it appears so pleasing and natural that he often entirely forgets to focus. I had that trouble myself when I first tried this type of camera. It disappears as soon as you get over admiring the pretty colors on the ground glass and pay some attention to getting the details sharply focused.

There are certain rules to follow if you want the best results in fast action pictures. The first is never to take the subject moving directly across the field of the camera if you can avoid it. Always try for a quartering shot with the subject coming toward you. Even a thousandth of a second exposure will not stop all motion in a racing auto if you catch it at right angles.

The second rule is, never try to focus on the moving object itself. Always focus as carefully as possible on some spot on the ground at the point where the subject will pass and then press the button when the subject reaches that point.

The third rule is, use plenty of speed. A sprinter may, for example, be traveling only twenty miles an hour or so, but his foot, as he brings it forward, will move at least twice that fast.

The fourth rule is, watch the point of view. Sports such as hurdle races, broad and high

$10 *prize for best* ACTION PHOTO

FOR the most photographically perfect action picture submitted on or before August 1, 1932, POPULAR SCIENCE MONTHLY will pay $10. The only condition is that it must be taken during the months of June and July, 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional.

Mail both print and negative to the Photographic Editor not later than August 1, and mark your entry "July Photo Contest." You may enter several photos if you wish. No entries will be returned, however, unless accompanied by a self-addressed, stamped envelope.

The $10 prize for the best trick photograph entered in the tenth contest in this series (P. S. M., Mar. '32, p. 114) has been awarded to Emil Pearson, of Redgranite, Wis. The following won honorable mention in the same contest: O. R. Black, Bessemer City, N. C.; Leon F. Dow, Livermore Falls, Minn.; Loyce Gary, Dallas, Texas; Tom Griberg, Moline, Ill.; Leo J. Heffernan, New York, N. Y.; Leo Leonard, Edwardsville, Pa.; Edwin E. Niessner, Redfield, S. D.; Herbert Norman, Lodi, N. J.; Joseph Serafin, Chicago, Ill.; Richard M. Snow, Jr., Rockland, Me.; Lyle Van Natta, Hallsville, Mo.; Robert White, Drayton Plains, Mich. The winner of the April contest will be announced next month.

jumping, diving, and similar stunts should be taken with the camera held low. The resulting picture always seems more impressive than one taken from the normal level.

In order to illustrate some of these points, I have taken the two snapshots which appear at the top of page 94.

Both were taken with a folding camera having the highest grade between-the-lens shutter. The exposure was maximum for the shutter, a two-hundredth of a second. The distance was twelve feet, and the camera was held two and one half feet from the ground.

Note how the jump over the small wooden box appears to be quite an exciting feat because of the low point of view. See how much less motion shows in the right-hand picture, which was taken head on, as compared with the left-hand view, in which the little girl was moving directly across the field of the camera. Observe that the box, which was the point focused, is sharp, proving that what fuzziness there is in the subject is due solely to the motion, which was too rapid for the shutter used.

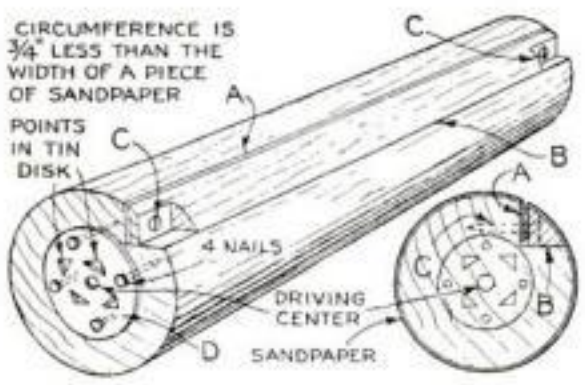
These two photographs show that even the best between-the-lens shutter is not up to such work. Both pictures would have been clear and sharp if they had been taken with a camera having a focal plane shutter working at high speed.

The next article in this series will be on miniature cameras. Mr. Ryder will be glad to answer any questions on taking photographs. Address him in care of this magazine and inclose a self-addressed, stamped envelope for his reply. In sending a print to be criticized, inclose the film also.

A SIMPLE WAY TO MAKE SANDPAPER ROLLS

AFTER long enduring the vexation of having to soak sandpaper off a roll and glue on another piece, I devised the simple roll illustrated below, upon which it is easy to replace worn-out sandpaper or change to a different grade.

The roll is turned to a circumference ¾ in. shorter than the width of a piece of sandpaper. Two saw cuts *A* and *B* are made lengthwise of the roll as shown, and a portion



Although a lathe sander is described, this method can be applied to any sanding drum

of each end of the removed piece is cut away to leave clearance for the screws *C*. The sandpaper is prepared by laying it on a board exactly as wide as the circumference of the roll and creasing over each edge for ⅛ in. The sandpaper is then placed on the roll with the turned edges in saw slot *A*, and the screws are tightened. For very fine sandpaper it is necessary to insert a strip of cardboard in slot *A* before placing the sandpaper in order to obtain a tight grip.

To prevent the driven end of the wood cylinder from wearing out, a circle of tin *D*, indented with the spurs of the driving center, is fastened to the end of the roll with four small nails.—C.F.B.

Economical and Timesaving Construction KITS

for your home workshop

KIT NO. 4

KIT NO. 1

AS A SERVICE to readers who find it difficult to obtain suitable materials for building high-grade furniture and models, the Popular Science Homecraft Guild has assembled the kits listed below.

The numbered kits, which are also marked "ready to assemble," contain the completely machined wooden parts, the necessary hardware, and the Guild finishes. The other kits, identified by letters, contain the raw materials alone (without paints or finishes) and are for craftsmen who wish to do all the work themselves. All kits are accompanied by instructions or blueprints. Because of heavy shipping charges, the prices are 50 cents higher west of the Mississippi River.

KIT NO. 2

No. 1. Colonial maple butterfly table with oval top 17 by 22 in., and 22½ in. high. Ready to assemble..... $6.90

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 3A. The same table in solid mahogany. Ready to assemble..... 8.15

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30

A. Whaling ship model *Wanderer*. All the raw materials—wood, sheet brass, and copper, five sizes of wire, four sizes of fishing line, fine chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154..... 6.90

B. Folding muffin stand in selected sugar pine, 11 in. wide, 19 in. long and 33 in. high when open. All the necessary wood cut to approximate sizes but not machined in any way, together with the screws..... 2.90

C. Muffin stand in birch (can be finished as maple, walnut, or mahogany)..... 2.90

KIT A

KITS B AND C

KITS NOS. 3 AND 3A

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☐ No. 2.	$5.90	☐ A	$6.90
☐ No. 3.	$7.15	☐ B	$2.90
☐ No. 3A.	$8.15	☐ C	$2.90

All prices are 50 cents higher west of the Mississippi River because of heavy shipping charges. This offer is made only to readers in the United States.

Name .....

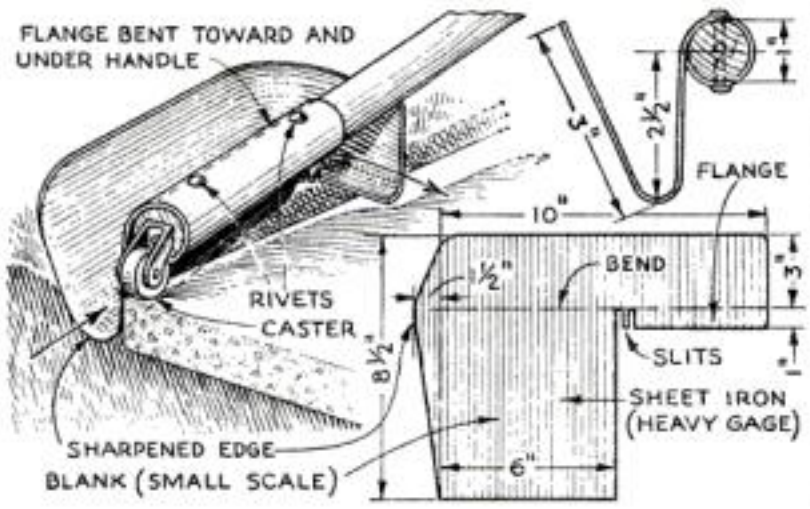
Address .....

City ..... State .....

(Please print name very clearly.)

LAWN EDGER THROWS SOD ON WALK

EDGING a lawn about sidewalks becomes an easy task with the tool illustrated. This not only cuts the sod accurately at a given distance from the sidewalk, but also keeps a constant angle at the edge, throws the cut sod up on the sidewalk, wears only very slowly, and can be operated at least two or three times as fast as an ordinary edger. Besides, it is easy to construct from odds and ends.



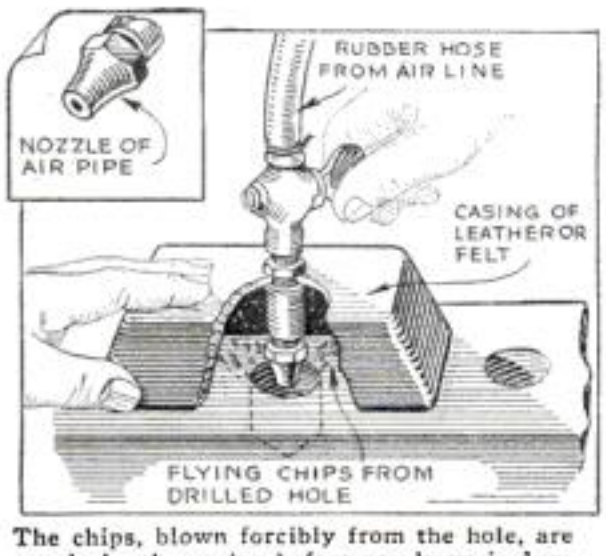
How the edger is used, a pattern for cutting the metal, and a cross section showing the way the metal is bent V-shaped

Materials necessary are a piece of sheet iron 8½ by 11½ in. of fairly heavy gage, a discarded broom or garden tool handle, a caster, and two small rivets 1¼ in. long. The sheet iron is cut to the shape shown in the lower right-hand corner of the drawings. The point on the left-hand edge will become the cutting edge, while the narrow right-hand portion becomes the turning flange. The blank is first rolled parallel to the bend to form a socket for the handle. The *V* is then bent at any desired angle; mine is about 45 deg. Several small slits are cut in the skirt extending to, and perpendicular to, the bottom of the V. The 1-in. skirt is then bent to form a continuation of the V, and the 3 in. wide part of the flange is bent around to carry the sod onto the sidewalk. The handle is inserted, drilled, and riveted; and the caster is fastened solidly in a hole drilled in the end of the handle. The edger is then complete except for sharpening the cutting edge with a file or grinder.

Two important points should be remembered in making the edger: The caster should be fastened so that it cannot turn about its axis. In bending up the skirt to form a V, the slits just at that curve should be overlapped as in shingling so that the sod slips naturally from one to the other. It will be found that the angle at which the handle is held will cause the cutting edge to be perpendicular to the walk—or vertical—and the sod-turning flange to extend over the walk as it should. If no caster is available, the first rivet can be moved down to the end to act as a bearing against the walk, but in that case should be of the button-head variety. The caster, however, is the better arrangement.

A pan or scoop similar to those used for catching grass behind a lawn mower may be attached to the handle and the sod-turning flange extended onto it. This avoids the necessity of cleaning the walk but is rather cumbersome. I prefer to use a shovel and broom, since in any case the walk must normally be swept after the grass is cut.—E. J. TANGERMAN.

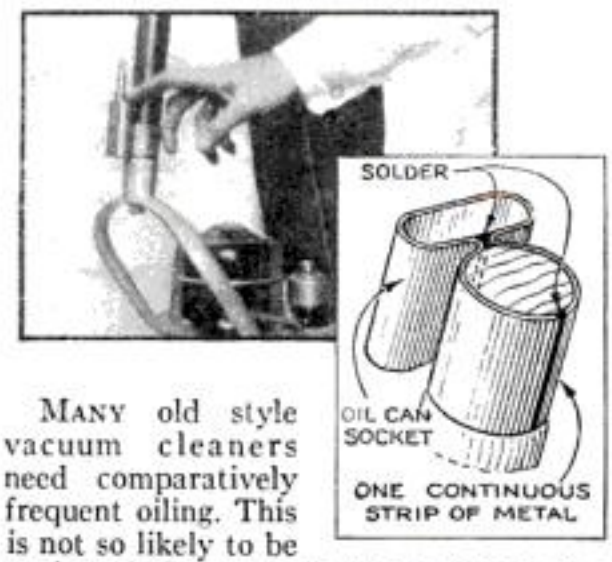
BLOWING CHIPS SAFELY FROM DRILLED HOLES



The chips, blown forcibly from the hole, are caught by the casing before any harm is done

AFTER seeing a machinist get cast-iron borings in his eyes while blowing out a drilled hole with an ordinary blowpipe, I made the device illustrated in the sketch above. It is connected with an air line near the drill press by means of a rubber hose and pressed down over the hole to be cleaned out. Then the valve is turned on, and the chips, as they are expelled from the hole, are caught by the shield. The casing of the original model was made of wood, but I believe that heavy felt or leather might be used to advantage because both could be squeezed closer to the work and would adjust themselves to any ordinary irregularities. The tip of the nozzle should project below the casing to facilitate locating it directly over the hole.—THOMAS MACE.

KEEPING OLD VACUUM CLEANERS OILED



MANY old style vacuum cleaners need comparatively frequent oiling. This is not so likely to be neglected if a ten-cent oil can is kept in a socket attached to the handle as illustrated in the photograph and drawing above.—H. J. C.

A DAINTY SEWING CABINET

(Continued from page 79)

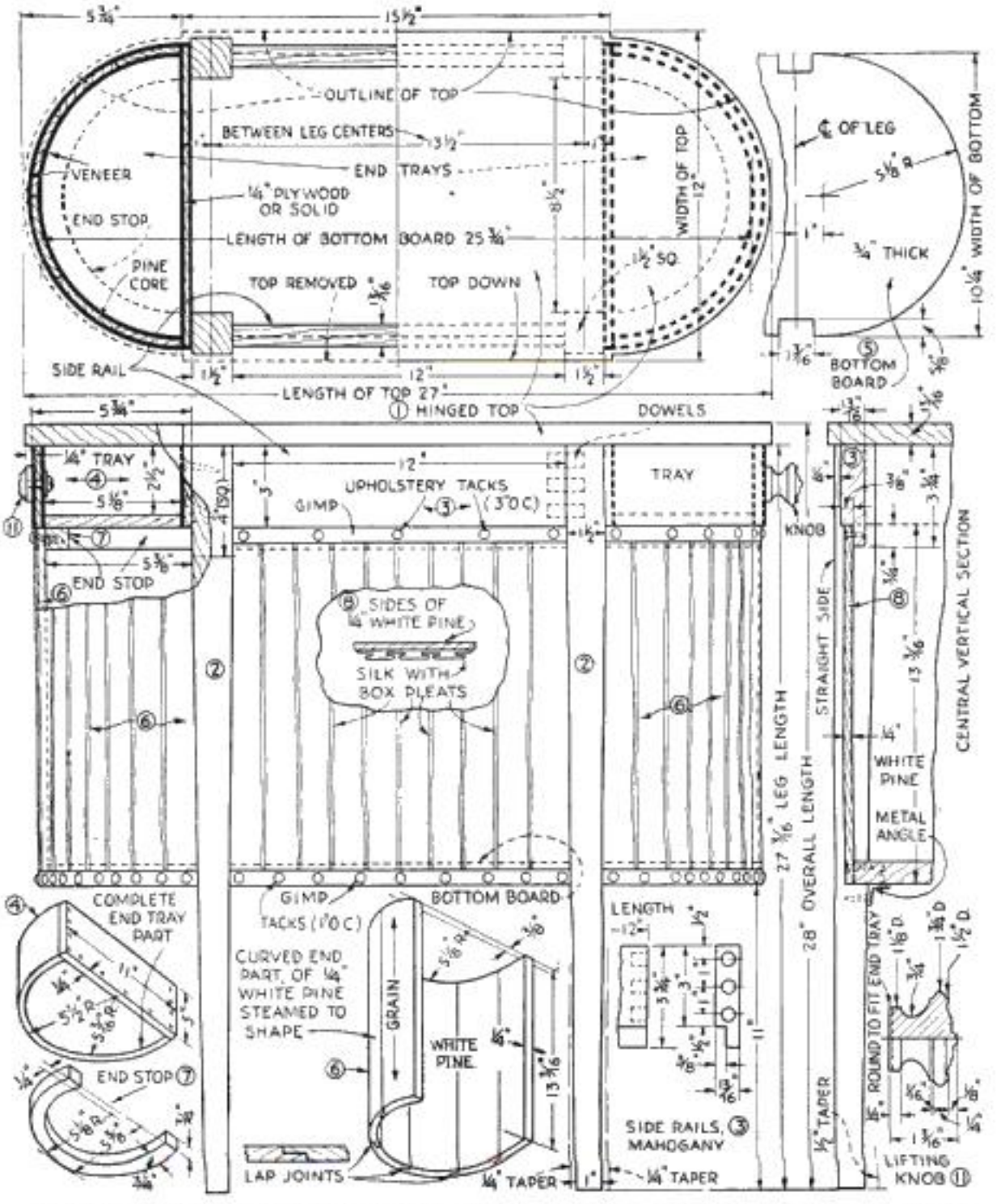
No. 7 being cut by means of this set-up).

For applying the pressure evenly around the circumference, a piece of sheet metal 3 in. wide may be used. The ends of this are bent up and reënforced with maple blocks to distribute the pressure of the clamps evenly across the width. A stiff piece of wood across the flat side of the form and projecting on each end serves to hold the other end of the C-clamp. The exposed surfaces of the veneer should be protected with several thicknesses of paper placed against the form and inside the metal clamping band.

The curved side as it comes from the clamp appears at the right of the photograph which shows the clamping operation. The veneered piece should be jointed on one edge, trimmed on the saw to 3 in. wide, and the ends cut about ⅛ in. over the true half circle. Each tray bottom is cut from ½-in. white pine to a true half circle of 5 3/16 in. radius and glued and clamped inside the built-up semicircular side. Then the inside veneer and the core of the curved side are cut away, leaving the outside veneer projecting about 5/16 in. to cover the end grain of the straight side, which is nailed and glued in place. The curved end stop No. 7 should now be glued and bradded to the bottom of the tray.

The legs, No. 2, and the side rails, No. 3, should be made as shown and joined with dowels or mortise and tenon joints, as preferred. They should be glued up in pairs and set aside while the bottom, No. 5, is made up. The size of the notches should be checked with the actual leg size at a point 11 in. from the lower end, and cut so the legs will fit snugly. In any case lay out the notches on the 13½-in. centers and spring the legs into them if they prove to be slightly out of line. Then screw the metal angle clips in the correct position on the legs.

The end trays, leg and rail units, and bottom may now be assembled with clamps and squared up. Locate the correct position of the end trays on the legs with brads partially driven. Then glue and clamp these parts together. For additional security, screws to fasten the tray to the legs are driven through previously made holes in the flat side of the end tray, as suggested in the drawings. The curved ends, No. 6, and the side, No. 8, may then be trimmed to size and screwed and glued



Complete drawings of the sewing cabinet. Those who wish to work from much larger drawings should send 50 cents for Special Blueprint No. 178A. A coupon appears on page 100

in place. Note that the vertical edges of the curved ends 6 must be trimmed to fit against the tapered leg.

The knobs, No. 11, are now turned and drilled for a fastening screw. The side against the end, of course, must be rounded out to fit the curve.

The top, built up of solid wood or of 13/16-in. plywood with veneered edges, is hinged to the side rails with two butt hinges. Be careful to set the hinges so that the top clears the outside of the legs. A sliding brass top support is attached to the top and the straight side of the tray.

The mahogany portions of this model were finished with stain and filler, one coat of thin shellac, and two coats of wax. This finish approximates the appearance of the original but requires periodic rewaxing. The pine portion, inside and out, was given two coats of orange shellac.

The silk is put on with gimp and furniture upholstering tacks after a box pleat about 1¼ in. wide has been sewed in the upper and lower edges. Where the silk adjoins the legs, it may be folded under and fastened with small tacks in such a way as to conceal their heads. A touch of glue along the edges will aid in keeping the silk in place.

LIST OF MATERIALS

Part No.	Name	Req. No.	Mat.*	Size and Remarks†
1	Top	1	M	13/16 x 12 x 27
2	Legs	4‡	M	1½ x 1½ x 27 3/16
3	Side rails	2	M	13/16 x 3¾ x 12
4	End trays	2	M	Half-round, 5¾ R., 3 high
			WP	(see drawings)
5	Bottom	1	WP	¾ x 10¼ 25⅝
6	Curved ends	2	WP	¼ x 13 3/16 x 17½
7	End stops	2	WP	⅜ thick, 5⅜ R., ⅝ wide
8	Sides	2	WP	¼ x 13 3/16 x 12¼
9	Butt hinges	2	B	2 x 2
10	Top supports	2	B	
11	Knobs	2	M	Turned
	Silk, glue, screws, etc.			

*Key to materials: M, mahogany; WP, white pine; B, brass

†All dimensions are given in inches

‡2 right-hand, 2 left-hand

AWKWARD GLUED JOINTS BOUND WITH RUBBER

To INSURE strong glued joints it is essential to apply firm pressure during the drying period. It is often impossible, however, to use clamps because of the number or shape of the surfaces requiring pressure. In many such cases, winding with thin strip rubber will often give the desired pressure.

The exuding glue does not prevent the removal of the rubber.—A. W. MILLER.

HOMEMADE MINIATURE CAMERA

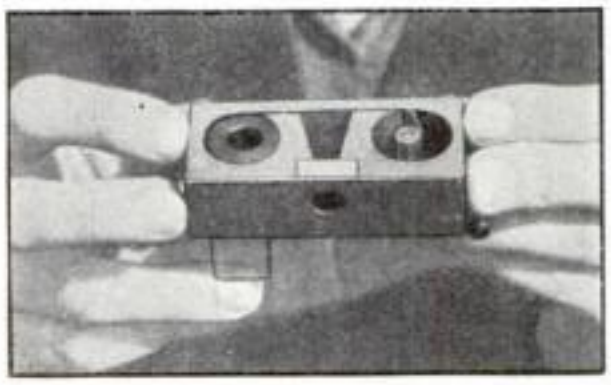
(Continued from page 86)

Fig. 8, install the wooden wedge shown in Fig. 7, first sinking a screw flush into the wall of the film slot opposite *C*.

Hook the shutter spring to peg *C*, Fig. 8, and slide the shutter to the left until the hole is only ⅛ in. to the right of the diaphragm opening. Insert peg *D* for a backstop. Now pull the shutter across until the hole is ⅛-in. on the left side of the aperture, and insert peg *E*. Drive a brad *F* at the lower right-hand corner of the shutter when in this second position. The tension of the spring twists the shutter so that its left corner rises and its right corner is drawn down against the brad, "cocking" the shutter. Bend a release wire as shown in Fig. 6 and attach it to block *H*, Fig. 8, with one end *G* free to move downward against the edge of the shutter. When this wire pushes down the left side of the shutter, the right corner is lifted above *F*, releasing the shutter.

Mount the film spool with knob *J* and two washers; then fasten block *H* in place and cover the camera with heavy black paper, all but the bottom. Invert the camera and place paper in the film slot, framing an image of the window at the edge of the paper. Place the finder so that when you look through the sighthole, the window fills the wire square. Incase the camera in a light-tight box and cover with leather if desired.

Standard movie film, cut in half, is rolled and placed in one film chamber, perforated side down. Figure 9 is a suggestion for a film cutter made from a razor blade. However, 16-mm. film may also be used. Draw the free end through the slot and wind it around the spool.



The underside of the camera with the outer case removed to show film slot and spools

When the shutter is being "cocked" for another picture, the finger must be held tight over the lens opening.

If the camera is found generally to overexpose, tighten the shutter spring or use a smaller diaphragm opening. If it underexposes, loosen the shutter or enlarge the aperture. If straight lines appear bulged or curved, the opening must be reduced and the exposure lengthened.

To develop, shake the exposed roll of film in a fruit jar of solution. The washing and fixing may be done similarly.

COLORING PHOTOGRAPHS

THE amateur photographer finds it is impossible to color glossy finished prints with water colors because of the wax left on the surface by the ferrotype plate. If the print is wiped off with carbon tetrachloride on a cotton swab, it is possible to use water colors and get equally as good results as are obtained on a waxless, smooth finish print.—WATSON C. COLE.

BLUEPRINTS *for Your Home Workshop*

For this month's new blueprint projects see pages 64, 67, 76, and 79

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions which appeared at the time the project was first published. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given.

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(See page 96 for kit of materials)	
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With complete kit of materials shipped anywhere in the United States east of the Mississippi	6.90
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Puzzles, Six Simple Block, *65*	.25
Swing, Porch, *10*	.25
Tool Cabinet, Bench Hook, etc., *30*	.25
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BUILDING OUR NEW SPORTBOAT

(Continued from page 69)

to which to cut the rabbet. This rabbet is chiseled out ⅜ in. "strong." After the planking is applied, the stem is planed flush. To prevent annoying leaks, drill ¼-in. holes at points indicated on the stem, then drive ¼-in. wood dowels in the holes after coating them well with glue.

The keel is now rabbeted, or, if desirable, a built-up keel may be made by fastening a ½ by 2 in. filler piece to the 1 by 4 in. keel with 1¼-in. No. 6 F. H. screws spaced about 6 in. apart. The keel is beveled and rabbeted before fastening it to the frames. Bevel the keel so that the bottom edges of the frames fit flush with the outside edge of the keel.

Place the assembled frames in their proper places on the form. Lay the keel in the keel slots, and clamp in place. Fasten the keel to each frame with two 2-in. No. 10 F. H. screws. Bolt the stem to the keel with two 4 by ¼ in. carriage bolts. Fasten wood strips from the floor to the stem and frames so as to hold them level and rigid. Let the keel extend over the transom frame 2 or 3 in. A few screws instead of clamps may be used to fasten the keel to the form, but remove the screws before the planking is applied.

SEE that the chine notches are beveled correctly. Square the frames and line up the stem. The chines are now fastened to each frame with one 2½-in. No. 10 F. H. screw. Countersink these screws well, especially up forward, as the chines will be beveled at these points. Fasten both sides simultaneously. To fasten one whole side at once will pull the frames out of shape. Bevel off the chines at the stem and fasten with one 1½-in. No. 8 F. H. screw on each side. Let the chines extend over the transom frame a few inches.

The inwales are next attached to each frame and stem with one 1¼-in. No. 6 F. H. screw. Before fastening the inwale, make certain the frames are properly spaced and the transom is at the correct angle. The inwale at the stem is notched flush with the faying (joining) surface.

NEXT the battens are attached. Divide and mark the space on the frames between the top of the inwale and the chine into four equal spaces. A light batten is clamped to the frames to ascertain if all of these marks line up exactly. After correcting any marks that may be slightly off, use a piece of the batten material about 6 in. long to mark the batten notches. A center line is marked on this short batten, and this must coincide with the mark on the frame; that is, one half of the batten must be on one side of the mark and one half on the other side. The battens are placed so that the plank edges will meet in the center. The battens are now notched flush with the edge of the frames. Be careful to fit the battens evenly. If they are slightly below or above the frame, this will make a depression or a raised area in the planking. Fasten the battens to the frames and stem with one 1¼-in. No. 6 F. H. screw at each joint. Bevel the ends of the battens at the stem so they fit flush with the bearding line. Let the after ends of the battens extend a few inches beyond the transom.

The ends of the inwales, battens, and chines are now trimmed flush with the transom frame. All but the filler piece of the keel is trimmed flush; this filler piece, which should extend 2 in., is trimmed off after the transom planking has been applied.

The transom planking is in two pieces. Clamp the transom planks to the transom frame, mark to shape, and saw out. Allow about 1 in. of the transom plank to project above the inwale. This is rounded off. Before fastening the transom planking, bore holes for, and insert, three dowel pins as shown. Coat the dowel pins, transom joint, and transom frame with casein glue. Clamp the transom planking to the transom frame and fasten with 1½-in. No. 8 F. H. screws, inserting the screws through the frame side 2½ in. apart.

The entire framework is now trimmed and faired so the planking will lie evenly.

At this point, go over the entire frame and see that everything is in shape.

The plank next to the chine is attached first. Bear in mind that when a strake of planking has been fastened on one side, the corresponding strake must then be fastened on the other side of the hull.

THERE are a number of methods for shaping the planks to fit properly. One way is to clamp the plank along the side where the measurement is to be taken. Mark the plank along the underside of the batten. Remove the plank and add one half of the width of the batten to this so the plank edges will meet in the center of the batten.

Another method is to use a light "spiling batten" about 3/16 by 3 in. as shown in one of the photographs on page 69. Lay the spiling batten along where the measurement is to be taken, whether it is a plank edge or a batten center line. Make certain that the spiling batten lies flat and does not twist. Take any convenient measurement from the batten center line or plank edge to the spiling batten at intervals of 8 in. The spiling batten is then laid on the plank material, and the marks are transferred to the plank. Lay a light batten on the plank so that it touches all the marks and draw a line connecting them. Saw out and plane to the mark.

It will be necessary to butt some of the planks, as extremely wide lumber would be necessary to plank in certain places with one continuous length. A butt block ⅜ by 8 in. and wide enough to fit between the battens is used to hold each butted joint together. Use ten 1-in. copper wire nails at each butt joint. Before fastening, apply "C" quality marine glue to plank edges and butt block.

Coat the stem, chines, and transom with marine glue and lay on strips of cloth. Clamp the first plank in its proper place and commence fastening it at the stem. Fasten each plank to the chines, frames, and stem with 1¼-in. No. 6 F. H. screws spaced about 2½ in. apart. Use a double row of screws on the planks at the transom. Fasten the planks to the battens and inwale with 1-in. copper nails spaced about 2½ in. apart. The nails should be clinched on the inside. Drill lead holes for all screws and nails.

WITH the sides planked, trim and fair the bottom, and be careful to trim the chines so the planking will lie evenly. The space between the chines and keel is divided into five equal spaces. Notch battens in as before. Fasten the battens to frames, stem, and transom with 1¼-in. No. 6 F. H. screws.

The bottom planks are attached in the same manner as the side planks. The transom, keel, battens, stem, and chines are coated with marine glue, and strips of cloth laid upon the glued surface. If the first two planks are wrapped in sacks and hot water is poured on them, it will greatly facilitate bending. Commence with the garboard plank—the one next to the keel—and plank out to the chine. Fasten the planks to the keel, stem, chines, and transom with 1¼-in. No. 6 F. H. screws spaced about 2½ in. apart. Use a double row of screws at the transom. The planks are fastened to the battens with 1-in. copper cut nails. If soft wood planks are used, leave a 1/16-in. seam between the bottom planks and fill with candle wicking and seam filler.

(Continued on page 102)

HOW TO BUILD OUR NEW *SPORTBOAT*

(Continued from page 101)

Complete List of Materials

For	Pcs.	T.	W.	L.	Material*
Planking: sides	8	5/8"	8"	16'	M, Cy, WP, WC, or RC
bottom	10	5/8"	8"	16'	"
Decking	5	½"	6"	10'	M, WP, WC, RC, or O
Plank sheer	2	½"	12"	8'	"
" "	2	½"	12"	10'	"
Coaming	2	½"	6"	10'	M, O, or A
Inside sheathing	8	3/16"	3"	12'	M, C, WP, YP, or F
Transom	1	1⅛"	12"	10'	M or O
Floor Boards	10	½"	6"	10'	F, YP, R, O, or WP
Sheer Molding (half-round)	2	9/16"	1⅛"	17'	M, O, or A
Keel	1	1½"	4"	14'	O or A
Keel (if built up)	1	1"	4"	14'	"
	1	½"	2"	14'	"
Chines	2	1"	1¼"	16'	O or YP
Clamps or inwales	2	⅝"	1½"	16'	O, F, or YP
Battens	14	⅝"	1½"	16'	"
Frames	3	⅝"	12"	16'	O or M
Deck beams	2	⅝"	10"	10'	O, F, or YP
Seat Riser	2	¾"	1¾"	8'	"
Floor timbers	4	¾"	4"	10'	"
Coaming supports	1	¾"	4"	8'	"
Coaming blocks	1	¾"	3½"	12'	YP, F, or S
Carlins	2	⅝"	1⅛"	16'	O, F, or YP
Stem	1	1¾"	8"	6'	O or A
Transom knee and breast hook	1	1¾"	14"	3'	"
Motor board	1	¾"	12"	4'	O, M, YP
Coaming molding (quarter-round)	2	⅜"		5'	M, O, or A
	2	⅜"		10'	"
Seats: frames	3	¾"	4"	12'	S, F, or YP
supports	1	2"	4"	8'	"
sheathing	3	⅜"	10"	12'	"
backs	1	¾"	12"	12'	"
	1	¾"	8"	12'	"
bottoms	1	¼"	2"	10'	F Plywood
	3	¾"	¾"	16'	S, F, or YP
Windshield:					
stanchion	1	⅜"	8"	5'	M or O
coaming piece	1	¾"	6"	54"	"
toppiece	1	¾"	1½"	54"	"
frame	1	¾"	1⅜"	12'	"
Top and stanchions:					
stringers	1	¾"	2½"	14'	M, A, S, or O
end piece	1	¾"	2½"	5'	"
forward beam and nose piece	1	¾"	1¾"	10'	"
visor piece	1	1⅜"	4¼"	5'	"
battens	5	5/16"	1½"	14'	"
nailing piece	1	⅜"	1½"	5'	"
beams	1	½"	12"	12'	"
center stanchions	1	⅞"	4"	5'	"
after stanchions	1	⅞"	18"	6'	"
Gussets	1	⅜"	12"	12"	M, O, or F Plywood

*Key to materials: A, ash; C, cedar; Cy, cypress; F, fir; M, mahogany; O, oak; R, redwood; RC, red cedar; S, spruce; WC, white cedar; WP, white pine; YP, yellow pine.

HARDWARE AND MISCELLANEOUS

F. H. screws, brass or galvanized: 18 gross 1¼" No. 6; 3 doz. 2½" No. 10; 4 doz. 2" No. 10; 8 doz. 1¾" No. 8; 4—3" No. 10; 4 doz. ½" No. 6 (for seat hinges)
R. H. screws: 4—2" No. 12
Carriage bolts brass or galvanized: 6—6" by ¼"; 36—1½" by ¼" (if rivets below are not used); 12—1¾" by ¼"
24—¼" wing nuts
50—1⅛" F. H. copper rivets (for frames)
2 lb. 1" copper wire nails
2 lb. 1" copper cut nails
½ lb. 1½" finishing nails
Small quantity ¾" and 1" wire brads
300—⅜" wood plugs to match decking used (for concealing screws)
3 pt. "C" quality marine glue
2 lb. waterproof casein glue
Strips of cloth
2 gal. spar varnish
1 pt. mahogany stain (for mahogany)
4 lb. paste wood filler (for open grained woods)
2 lb. elastic seam filler
2 qt. red or green bottom paint
1 qt. inside floor paint

FITTINGS FOR HULL

Windshield glass (double strength), approximately 10" by 45"
3 brass butt hinges 1¼" by 2" and 18-5/8" No. 6 F. H. brass screws
6' continuous 1½" brass hinge
6' flat brass strip ⅛" by 1"
2 6" windshield stay joints
2 3" brass door pulls (for windshield)
5' ⅜" half-round brass (for stem)
1 bulkhead runabout steering wheel
4 ¾" blocks for steering gear
30' ¼" steering cable
1 outboard combination light
1 outboard combination bow chock
2 5" open base brass cleats

UPHOLSTERING MATERIALS

6 yd. artificial leather 54" wide
25 yd. imitation leather gimp
200 upholstering nails (to match leather)
½ lb. 5/16" tacks
10 ft. chicken fence wire
4 yd. burlap 36" wide
6 lb. cotton batting
2½ yd. canvas 54" wide

EQUIPMENT REQUIRED BY LAW

1 combination running light (listed above), 1 anchor light, 1 whistle, 1 fire extinguisher, 1 life preserver for each person, 2 copies "Pilot Rules." Optional extra equipment for cruising: 14-gal. water tank 12" by 30"; 8-gal. auxiliary gas tank 12" by 24"; folding gas stove; folding curtains for sides

How to complete the boat will be told in the August issue

HAUNTED OIL FIELDS PUZZLE GEOLOGISTS

(Continued from page 15)

pumps a stream of cement to the bottom of the well, shutting off exhausted oil sands to keep out bottom water. To seal the next higher oil zone, a cement plug is built up, filling the casing for a distance of twenty feet.

Now the undertaker uses his casing cutter—a vicious-looking tool taller than a man and equipped with keen steel teeth that suddenly spring outward when a release is tripped. Down into the hole goes this strange surgical tool until it reaches the plug of cement.

Engines reverse. The catch trips. The deadly knives spring out as cables jerk; vicious teeth bite doggedly into the casing wall. A few revolutions of the drill pipe, and presto! the casing is free.

Now the crew has only to remove the drill pipe and pull up the salvaged casing. Up it comes, stand after stand, until pipe worth thousands of dollars is stacked in the derrick. The operation is repeated on each string of casing, until only a mere skeleton of pipe remains in the well.

A MORE spectacular rival to the oil field undertaker is the well shooter. Instead of the mechanical casing cutter, his tool is the "collar buster," a virtual torpedo filled with dynamite, which he sets off with uncanny accuracy at just the right spot to sever the casing. Haskell M. Greene, veteran well shooter of the Santa Fe Springs field, told me how nitroglycerin and dynamite, exploding with measured force, aid him in recovering thousands of dollars in treasure from dead wells.

Most startling of his methods is his newly invented "cement shot," in which cement, sandwiched between two charges of dynamite, is compressed instantaneously into artificial rock. Lowering the "sandwich" to a depth measured precisely by an instrument actuated by the descending cable, he sets off the two charges simultaneously. The cement, struck on each side by hammerlike blows at the rate of 26,000 feet per second, hardens instantly into a "rock" that yields slowly even to the rotary drill.

Green next applies the collar-buster—a metal torpedo loaded with dynamite and bearing a set of metal feelers, wire projections that spring tightly against the casing wall. When the torpedo hits bottom, it is then drawn slightly upward until the metal feelers engage the first collar between joining sections of pipe, registering a slight pull upon a meter at the surface. Green then detonates the charge, which expands the collar outwards, freeing the pipe, often without even injuring the threads.

WHEN all possible salvage has been recovered in this manner, the upper end of the pipe is plugged, the site leveled, and the well pronounced dead.

A unique experiment is now being tried in the Pecos Valley of New Mexico, where oil and water have mixed with sad results. Artesian water has ruined two oil wells and necessitated abandonment. At the same time it has become necessary to find an inexpensive way to plug 700 abandoned artesian wells that are draining the water basin of the district.

By a method conceived by J. B. Taylor, M. W. Erwin, and George M. Neel, heavy, low-gravity oil, heated to 400 degrees, will be pumped into the wells through a two-inch tubing. When it reaches the water level it will solidify, cutting off the artesian flow. The wells are to be first cleaned out and the water drowned with mud pumped in by a rotary rig. The *(Continued on page 104)*

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job will be finished by a plug of cement.

Not always, however, is a defunct oil well a "dead horse." Ranchers sometimes convert exhausted oil wells into water wells simply by perforating the pipe, using an ugly-looking tool much like a casing-cutter, with strong spring teeth that punch holes to tap zones of flowing water.

Near Los Angeles, recently, the owners of a large tract of land induced one of the major oil companies to drill a test well for them at cost, with the understanding that if oil were found, more wells would be drilled on a royalty basis. No oil was located; but the landowners had another ace up their sleeve. Under the terms of the contract, the oil company was to complete the hole as a water well if possible, rather than abandon it. The drillers tapped a water zone yielding 1,400 gallons per minute of a superior drinking water.

Although their $32,000 experiment resulted in not a drop of oil, the owners have built up a thriving business selling this water to Los Angeles residents at the rate of fifty cents per five-gallon bottle. At the same time, gasoline is retailing at nine and one half cents per gallon, of which the state collects 3 cents tax, the remainder being distributed among six or seven middlemen. As royalty holders in a producing oil well, the landowners would have received only one eighth of the wholesale crude oil price, before the refining process. As sole owners of a live water well, they receive all the proceeds, and have only to bottle and deliver the water directly to the consumer, receiving ten cents per gallon instead of about half a cent.

HOW TO BUILD YOUR AMATEUR TRANSMITTER

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the two coils are separately tuned to the transmitting wave length by individual condensers. $L3$ and condenser $C1$ form the tuned plate circuit, and $B1$ and $B2$ with condenser $C2$ form the tuned grid circuit.

Note that the plate of one tube connects to one end of $L3$ and the plate of the other tube connects to the other end of the coil. A similar arrangement of the grid connections are made to the ends of $B1$ and $B2$. A push-pull circuit works best if the work is evenly divided between both tubes. To get this result, the circuit should be as symmetrical as possible. In other words, corresponding grid and plate leads from the tubes should be of equal length. Do not attempt to rearrange the apparatus, as the layout shown gives short and symmetrical leads for both sides of the push-pull circuit.

Of course, minor changes in the spreading out of the parts will do no harm, provided the layout remains uniform and symmetrical. Sufficient accuracy in laying out the parts will be obtained by placing them in position on the undrilled panel, following the arrangement shown as closely as you can by eye measurement.

You will find Blueprints Nos. 183 and 184 a big help in building the transmitter. These supply details that could not be included on these pages and also give antenna, power supply, and keying instructions which will be discussed at length next month.

You are not permitted to operate an amateur short wave transmitter until you have obtained an amateur operator's license from the Government. However, this circuit will oscillate with no antenna attached, and can therefore be set up and tuned to the various wave lengths before you get your license and hook up the antenna.

RADIUM KILLS IN HANDS OF QUACKS

(Continued from page 11)

prescribes radium as a drug. All that the medical profession uses is radium radiation.

More than 100,000 persons die of cancer in the United States each year and, aside from the surgeon's knife, radium and X-rays (which resemble gamma rays) are the only weapons developed thus far to combat the disease. Radium is a proven cure for certain types of cancer in their early stages. In advanced forms of the disease, it is valuable mostly as a means of prolonging the patient's life, and making him comfortable.

Two methods of applying radium are used in cancer treatment. Radium itself in salt form is the source of radiation in one; in the other, radium emanation, or radon, serves this purpose. The metallic radium isolated by Madame Curie in 1911, thirteen years after she and her husband discovered the element, is a white metallic substance that cannot be conserved without alteration. Thus, for medical purposes, radium is used in the form of salts—radium sulphate for the "direct" method, and radium bromide, which is soluble, for the production of radon.

WHEN radium itself is the source of radiation, the salt is enclosed in sealed glass containers which, in turn, are placed in a metal "applicator," usually made of brass. The glass absorbs the alpha rays. The metal is sufficiently thick to absorb the beta rays, while acting as a "filter" through which the penetrating and curative gamma rays can pass, almost without loss. In treating a patient, the specialist holds the applicator close to the skin at carefully calculated distances varying with the degree of penetration required in each case.

Another way of applying radium salt to patients is to enclose it in tiny glass tubes that are put in metal containers called "needles," which are inserted into the diseased tissue with a steel plunger and left there for the required length of time. A number of metals are known to absorb the unwanted rays while filtering the gammas—aluminum, brass, copper, silver, lead, gold, and platinum, effective in the order named. As platinum is the best, the needles now are made of this metal.

Lead is not only the most efficient base metal for the purpose but even better than silver and it, therefore, is used for large containers to transport radium.

When radium emanation serves as the radiation source, the radon gas, whose strength is nearly the same as that of radium itself but very short-lived, is enclosed in minute glass containers which are sealed in tiny soft-gold or platinum tubes called "seeds." Like the larger radium-salt needles, the seeds are inserted into the tumor with a plunger.

In the last ten years, the emanation method has found much favor with the medical profession, and all cancer clinics now use it in addition to direct application. It has several advantages. First, one specialist told me, it is applicable to a wider variety of cases. Secondly, when radon seeds are employed, there is no need to confine—and carefully watch!—the patient in a hospital room and to take out heavy insurance, all of which is necessary when a quantity of the precious radium itself is inserted into part of the sick man's body. In the third place, the soft-gold or platinum seeds, which are only about four and one half millimeters, or a little over one sixth of an inch long, and one millimeter, or about one twenty fifth of an inch, in diameter, may be left in the tissue without harm to the patient. They do carry a thread by which to pull them out when removal is desired, but this usually is snipped off before insertion. The average price of one such little seed is $20, and it can be used only once.

But the emanation method has one disadvantage. While radon has almost as much potency as radium, it loses half its strength not in 1,730 years but in three days and twenty hours, and all of it not in 19,000 years, but one month. Thus any given quantity of radon is a self-diminishing dose, and the seeds must be renewed constantly to have any appreciable effect. Incidentally, this also will give you an idea of how little benefit may be derived from drinking bottled radon water!

RECENTLY, I visited a laboratory where radon seeds are prepared for hospitals, cancer clinics, and private practitioners. The physicist in charge ushered me into a lead-lined room.

"How would you like to see a quarter of a million dollars' worth of radium?" asked my guide, opening a small, lead-lined steel safe. All I saw was a pint flask partly filled with water.

"Where is the radium?" I asked.

"Right in front of you, in that flask," was the answer. I had forgotten that, to produce radon, a solution of radium bromide is used!

The flask was joined to a glass tube which, leading through the top of the safe, was connected to an array of glass apparatus, consisting mainly of two mercury pumps and a purification chamber. By means of one of the pumps, the gas, which rises to the surface of the solution in minute quantities, is taken to the purification tube, where it is freed from impurities by a chemical process. The second pump forces it into a capillary tube about the diameter of a pin. It is this tube which, by a simple process, is divided into the tiny glass seeds. An operator, at short intervals, holds it over a gas flame, simultaneously cutting the tube into seeds and sealing them. After that, they are put in gold or platinum jackets, and are ready for use. Each seed contains a quantity of emanation whose strength is about equal to one thousandth of a gram of radium. This amount is called one millicurie, in honor of the discoverers of radium.

That the medical profession, which has great faith in radium as a curative agent, is thoroughly aware of its menace is shown by the elaborate precautions taken in dealing with it. Take for example the laboratory I have just described.

At one point in the process of collecting the radon it is necessary to concentrate the gas in amounts dangerous to the health of the laboratory technicians. To protect them, an electrical control device automatically flashes a red light when the danger point is reached. When the operators, who work behind a lead partition, see the signal, they leave the laboratory to return after a few hours, when the gas has been piped into the capillary tube.

Even then, the constant proximity to the radioactive gas is so detrimental to health that technicians are required to work only three weeks a month, and are given a month's vacation each year. As has been said, radon contains no alpha particles. While those working with it thus are not threatened with necrosis, the danger of anemia remains. For that reason, a blood count of each operator is taken once a month, and when it is found that the number of white blood cells has fallen below normal, the man affected is granted a furlough in which to recuperate.

Physicians literally handle radium with gloves—rubber ones—which they put on before working with radium-salt tubes and radon seeds to protect their hands against beta-ray burns. But even thus safeguarded,

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they take no chances. They never touch the tubes or needles but pick them up with wooden tongs. In carrying radium from one part of a hospital to another, long-handled boxes are used. When applying it to patients, doctors do so from behind lead plates at least one inch thick. In hospitals and clinics, radium in bulk, if that word may be applied to amounts seldom exceeding a few grams, is kept in holes drilled in thick lead blocks that are stored in a lead-lined vault removed as far as possible from wards, offices, and living quarters.

FEW hospitals possess radium in any considerable quantity because of its prohibitive cost. Although, of late years, the price has dropped almost fifty percent, radium still is the most expensive substance in the world. Its present value is from $50,000 to $60,000 a gram. One gram of diamond, such as jewelers use, costs from $2,000 to $3,000; one gram of industrial diamond, $875; one gram of platinum, about $2.50; one gram of gold, approximately seventy cents! To realize how little a gram is, remember that two and one half grams of granulated sugar can be piled on a dime!

Why is radium so expensive? The answer is simple. Hunting for the proverbial needle in a haystack is child's play compared to extracting radium from the ores that contain it. While visiting this country some years ago, Madame Curie who, although she discovered the element, never had possessed as much as one microgram of it, was presented with a gram of radium which she, in turn, donated to a hospital in her native city of Warsaw, Poland. To produce this one gram, 150 men worked more than one month with over 500 tons of ore, 10,000 tons of distilled water, 1,000 tons of coal, and 500 tons of chemicals!

AT THAT time, about seven-eighths of the world's radium supply came from carnotite ores found in Utah and Colorado. Today, radium is mined almost exclusively in the Belgian Congo, in central Africa where, in recent years, large and rich deposits of pitchblende (oxyde of uranium) and other radium-containing ores have been discovered. The radium market now is controlled by a Belgian trust. Because of the richer quality of the ores, less labor is involved in its production and the cost has been nearly halved as a result. When radium was mined in this country, the average price was $100,000 a gram.

This, in brief, is the process of refining radium: The ore is mined together with huge quantities of worthless rock. Sorted and sacked, it is hauled to the concentration mill, where it is reduced considerably in bulk before it is shipped to the extraction plant. There, the ore is treated with chemicals that remove all barium and radium salts. Then the tiny quantity of radium is separated from the large amount of barium accompanying it. This job alone requires twenty-five separate chemical processes! The last step, or rather series of steps, is repeated crystallization, or evaporation of the solution. With all the scientific improvements introduced in the thirty-one years since radium first was isolated, this purification process, curiously enough, today does not differ in any particular from that originated by Madame Curie in 1911!

Pure radium salt at first resembles powdered sugar with a mysterious, bluish phosphorescent glow. It loses some of this and acquires a brownish color when sealed in glass tubes. For industrial purposes, such as painting the numerals on luminous watch and clock dials, a minute quantity of radium is mixed with zinc sulphide, which causes it to give off a greenish yellow glow.

It is the involved operations needed for its preparation which keep the price of radium at about $55,000 for a pinch that just about covers the bottom of a teaspoon! No wonder that something closely resembling panic reigns whenever a bit of the precious substance is lost!

To recover lost radium, a simple but ingenious little apparatus known as an electroscope is brought into play. It consists of two strips of gold leaf hanging on a metal wire. When the wire is charged electrically, the strips spread apart, and stay thus so long as the air between them remains an insulator, or nonconductor, not allowing the electrical charge to "leak" off the leaves. Radium or any other radioactive substance, however, ionizes the air, or makes it a conductor of electricity. Therefore, if the electroscope, by great good luck, is placed near the spot where the radium was lost, the strips drop and the treasure is found.

A few weeks ago, people strolling through a park in Berlin were astonished to see a party of park guards, led by a civilian, crawling on hands and knees around a tennis court. Armed with an electroscope, they were hunting twenty milligrams of radium, about $1,000 worth, which a doctor had lost on his way to the lockers connected with the courts. For all that is known to the contrary, they still are hunting. Repeatedly, however, radium has been fished from ash barrels, dump heaps, drains, and piles of cinders with the aid of electroscopes.

THE world's total stock of refined radium today is approximately 300 grams, or two-thirds of a pound—$16,500,000 worth! Half of that amount is in the United States. Bellevue Hospital, New York City, a municipal institution admitting charity patients only, became the custodian of the largest quantity held anywhere the other day, when it received a one-year loan of five grams from the Belgian government. Added to its own store of five grams, this made ten grams, probably twice as much as is possessed by any other institution.

Will radium ever get cheaper? It may, if radium-containing ores discovered a few months ago in the Great Bear Lake district of northwestern Canada (P.S.M., April '32, p. 17) can be worked profitably. Recently, Dr. C. S. Piggott, of the Carnegie Institution, addressing a meeting of the American Geophysical Union, in Washington, D. C., amazed his listeners by declaring that the sea contains more radium than the dry land, and experiments indicate that a billion tons lie hidden on the floor of the Pacific Ocean! If this vast store can be brought to the surface, radium may become as cheap as any ordinary medicine.

Until that boon is bestowed on cancer sufferers, it is, in one way, just as well that radium is so difficult to get. Its prohibitive price at least keeps it out of the hands of many quacks and rash experimenters, who otherwise might spread death with this double-edged sword. Meanwhile, scientists may succeed in conquering its destructive force and making it the docile servant of mankind.

HUNT OYSTER BEDS FROM AN AIRPLANE

HUNTING OYSTERS from the air is a recent innovation over Chesapeake Bay along the Maryland coast. An aviator demonstrated that oyster beds which cannot be seen from the surface of the bay are visible from a plane.

GUS EXPLAINS MYSTERY OF VIBRATION IN CAR

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twisting itself right out of the frame trying to turn the shaft."

"I see," Joe interrupted. "They don't worry about the motor vibrations as long as they can keep them out of the rest of the car. Why didn't somebody think of that before?"

"Probably somebody did," Gus suggested, "but he didn't know how to apply the idea to an auto engine. Rubber mounting made it real easy and practical. Don't get the idea that floating power and rubber mounting are so effective that it isn't necessary to worry about motor vibrations any more.

"TAKE it from me, if you tried to apply floating power to some of the unbalanced auto engines they made years ago, you'd probably have the motor hop right out of the car if you tried to drive fast.

"No, rubber mounting and floating power are refinements that can be added only after you've done pretty near all the mechanical balancing that's possible. I can remember when a set of pistons was considered O. K. if they didn't vary in weight more than a few ounces. Now they match 'em on the cheapest cars to the fraction of an ounce; connecting rods the same way. In the old days crank shafts for cheap cars came through without any balancing at all and high grade car makers tested them only for static balance. Now nearly every one, including the cheapest, gets tested for dynamic balance."

"I understand pistons should be the same weight and so on," Joe again interrupted, "but I don't understand that static, dynamic balancing business. If you set a crank shaft with the end bearings resting on a couple of knife edges and you take metal off here and there till it doesn't have any tendency to roll because one throw is, maybe, a bit heavier than another, why shouldn't it be in perfect balance when you run it in the engine?"

"It would, if you were talking about a thin flywheel instead of a crank shaft," Gus explained. "The static or standing-still balance of the flywheel would be practically the same as its dynamic or running balance because all the weight is in one plane."

"How do they do the dynamic balancing?"

"In a special machine that rotates the crank shaft and registers which way it's out of balance," Gus explained.

"I THINK I've got a glimmer of an idea about that," said Joe after a minute or two. "Now explain one other thing that's always puzzled me about engine balancing. Why is it you can't balance a four-cylinder motor and get it just as smooth as a six? I never could understand why the two pistons coming down don't equal the other two pistons going up. If the pistons all weigh the same and so do the connecting rods, and the crank shaft is dynamically balanced, what is there left to cause vibration?"

"Better brains than yours or mine have puzzled over that one, Joe," Gus said with a grin. "The answer is what the engineers call the angularity of the crank shaft. If you measure the motion of the piston as it slides down the cylinder, you'll find it goes quite a bit more than halfway by the time the crank has reached the halfway point. Sounds impossible, but you can prove it for yourself in two minutes with a compass and a ruler. The only way you could get balance would be to put a pair of cylinders on opposite sides of the crank shaft. Then the irregular piston motions would balance."

"So that's it, eh?" said Joe as they reached the Model Garage. "Well, I'll take your word for it. Just goes to prove that whatever goes up must come down—but not the same way!"

IT DOES RAIN FISH!

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In Argyllshire, such showers were seen in 1796, 1817, and 1821; in Kinross-shire in 1825, and in Ross-shire in 1828. Of the Scottish accounts, the most entertaining is that of a fish rain near Aberdare in 1839, when a carpenter named John Lewis went "fishing" down his own neck. In a book by a British zoölogist, it is given in these words of the lucky fisherman himself:

"I was getting out a piece of timber for the purpose of setting it for the saw, when I was startled by something falling all over me, down my neck, on my head, and on my back. On putting my hand down my neck, I was surprised to find they were little fish. By this time I saw the whole ground covered with them. I took off my hat, the brim of which was full of them. They were jumping all about. They covered the ground in a long strip of about eighty yards by twelve yards, as we measured afterwards. There were two showers, with an interval of about ten minutes, and each shower lasted about two minutes. They came down with the rain in a body like."

THE heaviest fish fall is that described in 1861 by Count de Castelnau, famous French naturalist, whose reliability is above question. It took place during a terrific three-day rainstorm at Singapore following an earthquake in February of that year. Fifty acres of land were covered with fish!

Germany wins the palm for the strangest case, despite the fact that it involved only a single fish. But that one came down already packed in ice! During a violent hailstorm in Essen, in July, 1896, a hailstone the size of a hen's egg, eyewitnesses relate, fell onto the pavement of one of the main streets. Inside the hailstone a baby carp was found frozen!

Dr. Gudger found that fish rains have occurred as far north as the lonely Faroe Islands, southeast of Iceland in the Atlantic Ocean; and as far south as the Argentine, in South America. They have come down in Holland; in South Africa; in India, where they are more frequent than anywhere else; in the Malay Peninsula; on the island of Java, in the Dutch East Indies; in Australia; and in the South Sea Islands, where a certain species of tiny fish sometimes is found in the hollows of rocks and other places where no water except rain could possibly reach. The natives call it "topataua," which literally means rain drop. When Dr. Gudger completed his investigation, he realized he had followed a trail that encircled the world.

WHAT causes fish rains? Several theories have been offered in explanation of this curious phenomenon. Alexander von Humboldt, celebrated German scientist, in 1823 attributed it to volcanic eruptions. The reason was that the only fish rain of which he had knowledge followed an eruption in South America, where mountain streams were emptied of fish in the explosion. Count de Castelnau, also acquainted with but one occurrence—that accompanying the earthquake at Singapore—naturally gives earthquakes as the cause. Fish rains, however, have been observed in many countries where volcanic disturbances and earthquakes are unknown.

A third theory is that aestivation, or hibernation of fish, is at the bottom of the mystery. This explanation assumes that fish never really fall from the clouds, but that such creatures found on dry land simply were disturbed in their sleep and brought to the surface of the ground by heavy rains. There are several kinds of fish living in tropical regions, particularly India, which in the dry season bury themselves in the mud until the rains of the wet season waken them and set them free. In the first place, this theory would rule out all eyewitness accounts of fish actually dropping from above. Secondly, hibernating fish are found exclusively in the tropics, and aestivation, therefore, scarcely would explain fish rains in the Faroe Islands, in Scandinavia, Holland, Scotland, and the northern part of the United States.

Another somewhat similar hypothesis also dismisses as incredible the reports of fish dropping from the heavens. It advances fish migration as the cause. Fish encountered on dry land, it explains, belong to certain species which, when ponds and streams dry up, will travel overland in search of other waters, pulling themselves across the ground by their breast fins. Such fish actually exist. They are enabled to live out of water for short periods by a special organ, connected with the gills, in which they hold water while on land. But the trouble with this theory is that migratory fish, like hibernating ones, are found only in the tropics.

STRANGEST of all is a theory attributing the presence of fish on dry land to "spontaneous creation." It was formulated not in the dark ages, but in recent years. In 1915, George Prentiss, in a book entitled "The Ages of Ice and Creation," gave several modern instances of little fish having been found on plantations in the South. The author seriously explained that the fish, encountered between rows of cotton, had been "created on the spot," though he did not attempt to give a reason for their having been placed in so unfavorable an environment in which to live.

What is the right answer? Dr. Gudger has found that fish rains are caused by waterspouts. High winds, particularly whirlwinds, he told me, pick up water, fish and all, and carry them inland where, when the velocity of the air and clouds becomes relatively lowered, the fish fall to earth to the consternation of beholders.

"These whirlwinds," he said, "are comparable to the tornadoes that, in the Middle West, pick up houses, cars, mowing machines, and drop them again miles away. Anyone who has witnessed the activities of a strong whirlwind, and the wreckage left in its path, will have no difficulty in believing that such a twister, or even the heavy winds accompanying a severe storm, can pick up and transport to some distance objects as light as small fish. Besides, if you ever have noticed the tremendous power of waterspouts, such as are common in southern Florida, you will agree that such a spout, passing over shallow water, would certainly pick up the small fish in it and, drawing them up into the clouds, would carry them over the country to drop them further on—sometimes miles away."

Thus modern scientific investigation has solved another of Nature's mysteries, a phenomenon that had puzzled scholars and laymen for seventeen centuries.

INVENTS NEW MACHINE TO EAT GRASSHOPPERS

DESIGNED to devour grasshoppers and turn them into chicken-feed and fertilizer, an invention by Walter S. Jardine, a Nebraska State Representative, is expected to prove of value in combating insect plagues. The apparatus, attached to an automobile or tractor, will move across the fields sucking the insects into a huge metal hopper where they will be ground up and then expelled in long "windrows" to fertilize the ground or to be collected and fed to poultry. Jardine has applied for a patent upon his grasshopper-eating mechanism.

BUG EATS BUG TO SAVE FARMS

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me. From the very beginning the advantage is on her side, for she can raise a new generation every month. Thus the offspring of this amazing insect spread with 100 percent greater rapidity than do her enemies. Her method of attack on the latter is peculiar. Spying a black fly clinging to a citrus-plant leaf, she alights on it. Piercing it with her ovapositor, or stinger, she deposits an egg under it. Then she buzzes off to repeat the operation on the next black fly she sees, apparently forgetting all about the egg she left under the last one.

LONG before the black fly can reach the adult stage and take off from its leaf, the egg laid under it by the little wasp has hatched. One of these creatures in the grub stage instantly starts feeding on the black fly. It continues this method of subsistence until nothing remains of the black fly but a hollow shell. The young parasite, having reached the adult stage, bursts the hollow shell of its late host and flies off, to repeat the egg-laying process—if it be a female.

Such were the insects that Clausen attracted to the potted plants he had left standing in the pomelo groves of Malaysia. When a sufficiently larger number of the insects were seen to be interested in the infested plants, covers were clapped over the traplike cages in which they stood and the parasites were carried off. By this "Shanghaiing" process, Clausen told me he managed to land in Cuba a colony of forty-two females and nine male parasites of the black fly. These were all that survived the long ocean voyage from the other side of the world.

"It is too early yet to give you any facts and figures concerning the effect of these parasites on the citrus-fruit black fly in Cuba," said Clausen. "Entomologists, however, feel confident that the Cuban invasion has been checked and the menace of an invasion of Florida removed."

Previous to the citrus-fruit black fly expedition, Clausen had spent several years in Japan, Korea, and Manchuria. In those regions he sought parasites of the Japanese beetle, which had invaded this country and spread havoc and destruction in fruit orchards. The pest was believed to have entered the United States shortly before 1916, in earth packed around nursery shoots imported from Japan. It made its first appearance in New Jersey, over a region about one square mile in area. By 1925 the infested area covered 6,047 square miles. In less than two hours one morning in 1923, thirteen sixteen-gallon tubs of Japanese beetles were collected in one peach orchard merely by shaking the trees. Next day the same trees apparently were as thickly infested as before.

BEFORE such rapidity of breeding, man's artificial methods of coping with these insects are futile. Quarantine was resorted to in an effort to limit their spread. Inspectors were stationed at state boundaries to examine all interstate shipments of plants or nursery shoots. You may have been stopped, while motoring through the country, by inspectors enforcing this quarantine. Every effort was made to keep the beetles from traveling, but still they spread, ravaging fruit and shade trees and destroying plants.

Entomologists were instructed to search for insect parasites of the Japanese beetles. Since these destructive creatures came originally from Japan, it was felt that there was the most likely place to look for insects that would destroy them. Clausen, among other entomologists, was sent to the Orient to find enemies of the beetles. The work of this expedition, Clausen told me, was much more difficult than the trip he later made to Malaysia. In Japan he had to find insects about which nothing was known, and which were only thought to inhabit those latitudes.

"We had not only to find an insect deadly to the Japanese beetle," said Clausen, "but we had to get one hardy enough to stand transportation to this country, and one that would thrive in the climate of our infested areas. That was a big order to begin with, considering that we had half of Asia in which to search. For preliminary work of this campaign we employed much native labor. At one time we had as many as 200 men, women, and children working for us. Still it wasn't as difficult as you might imagine," he continued. "We simply gathered together all those who wanted to work for us and showed them specimens of beetles, both parasitized and unparasitized. At Sapporo, Japan, in this manner we collected in two years as many as 296,000 infested beetles. In one day in 1922, 56,000 parasitized beetles were brought in by this form of labor."

THESE field activities were begun in 1920 and are still going on. They have resulted in the introduction into this country, Clausen told me, of nine parasitic enemies, and one predatory foe of the Japanese beetle. Highly effective, throughout the larger portion of the infested areas in the United States, Clausen told me, is *Centeter cinerea*, a species of fly. In attacking a beetle, the female of this species deposits one of her own eggs on the enemy's thorax. The larva, when hatched, does not emerge from this tiny egg, but at once enters the body of the insect to which the egg is attached. Inside the beetle, it feeds on that creature's internal economy and does not emerge until the death of its host, when it comes forth as a full-grown *Centeter*.

Bodies of Japanese beetles killed by such creatures, and still containing larvae of their executioners, were packed for shipment to the United States in cardboard boxes of moist sphagnum moss. They were sent to the Department of Agriculture's Japanese beetle experimental station at Riverton, N. J. There larvae of the parasites of the beetles were bred in cages under laboratory conditions to make sure that they had successfully stood the long journey from Japan. When it was known that they had done so, they were liberated in beetle-infested areas.

ANOTHER parasite of the Japanese beetle found in northern Japan was discovered to employ a most amazing method of attack. Its work begins while the Japanese beetle, still in the grub stage, is living in the ground. Larvae of this parasite, *Prosena siberita*, are deposited on the ground, and immediately begin burrowing, looking for beetle grubs. When these are found, *Prosena* burrows into them and adds insult to injury by breathing through the beetle grub's respiratory system, and at the same time devouring the grub from inside out!

Clausen told me that economic entomology, the study of insect parasites of crops and plants, first was mentioned in this country during or shortly after the Revolutionary War. At that period, the Gage bug, Hessian fly, chinch bug, and coddling moth began their depredations on American farms. Finding themselves unable to cope with the invasion of these pests, early entomologists long discussed the practicability of importing insects to destroy them. Nothing, however, was done until many years later. In 1888 Albert Koebele, an entomologist of the Department of Agriculture, was sent to Australia to find parasites of the (Continued on page 110)

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fluted scale insects that were ravaging Californian citrus-fruit groves.

In the Antipodes, Koebele noticed that the Australian ladybird was an implacable enemy of the fluted scale, which was also found in Australia. He brought back with him to California several of these wonderful little creatures. After careful breeding they were finally released in the Californian groves, where they soon effected the complete extermination of the fluted scale.

Unknown to many but those actively engaged in it, the Department of Agriculture has for years been waging a bitter, and at times a seemingly hopeless, war against the gypsy moth in New England states. In 1880 a French scientist brought numbers of egg clusters of this pest to Medford, Mass., from France. He planned to use them in breeding experiments in the hope of producing a hardier race of silkworm. During the experiments some of the eggs were lost, or the caterpillars escaped. Realizing the danger, the Frenchman sounded a warning. Unfortunately for the United States, the insects bred at first slowly, and the people of Medford were lulled into a feeling of false security.

It was not until 1889 that they awakened to a sense of their danger. In the summer of that year, fruit and shade trees around Medford were almost completely defoliated. Strange caterpillars swarmed over everything, invading homes, getting into food.

Alarmed by these conditions, the state of Massachusetts voted funds for combating the menace. An area of 359 square miles around Boston was found to be infested. The work of fighting the pests went so well that again people were lulled into a feeling of false security. In 1900 the combat work ceased; it was believed that the pests had at last been brought under control.

Entomologists, I was told, now know this to have been a most ill-advised move. Within five years caterpillars of the gypsy moth were swarming over many parts of the New England states. This reappearance of the pest put an end to the truce, and war against it flared up with renewed vigor. Coincidentally with the new invasion an ally of the gypsy moth appeared on the scene—the brown-tail moth. Between them these two pests set to work destroying trees in New England.

By 1905, the work of importing insect enemies of the gypsy and brown-tail moth had begun. Since that time more than 93,000,000 parasites of these pests have been brought into this country and liberated in infested areas. Forty-seven species of these insect allies of man have been employed, of which fifteen are known to have firmly established themselves here.

The control of crop pests by the introduction of their natural parasites, say entomologists, is not the ideal method of combating such evils. They point out that it is very like waiting until a horse has been stolen before putting a lock on a barn door. In other words, agriculturalists must sit helplessly by and watch their crops infested by insect parasites before anything can be done to save the crops. But the fault here is man's and not Nature's. In the present state of knowledge of spraying methods and appliances, man can do little more than he has already done. Until we discover newer and better systems of chemical and mechanical control of crop pests, man must be content to let Nature do this work for him, combating his agricultural pests with her own weapons.

HOW SLEUTHS TRAP BOMB MURDERERS

(Continued from page 37)

Ordinary blasting fuse, its powder core surrounded by gutta-percha tar and yarn, burns at the rate of about two feet a minute. Some bombs have been found with as much as fifty feet of fuse, giving the murderer ample time to make his getaway.

Last March, a family of six escaped death at Mechanicville, N. Y., when they were awakened by the barking of a pet terrier. On the front porch, they found six sticks of dynamite in a tin can. The fuse had been lighted, but it burned long enough for them to escape.

Often, the type of fuse employed will give detectives a clue that leads to the capture of the criminal dynamiter. Consequently, professional bombers often use yarn rolled in gunpowder in place of regular fuse. It burns up completely and leaves no clues.

When an unexploded bomb is brought to the expert, every inch of it is combed for clues. Both the outside and inside of a box mechanism are studied for telltale fingerprints. The string, the wrapping paper, the fuse, wire, or battery are carefully noted. The explosive used is analyzed and studied.

Mechanism bombs are now being X-rayed to discover where the hidden springs and triggers are located. Often, a bomb-squad man will press such an infernal machine close to his face, sniffing to catch the smell of the explosive within. Dynamite, nitroglycerin, and gun cotton each has an odor by which the expert can identify it.

Most explosives used in bomb plots are stolen, so the police can't trace the purchase. "Any good thief can get dynamite or nitroglycerin," Dr. Charles E. Monroe, explosives expert of the Bureau of Mines, in Washington, D. C., asserted recently, pointing out the need for stricter supervision in the handling of high explosives. Albert V. Pitt, explosives authority and head of the Bureau of Public Safety of the Nassau County, N. Y., Police, told me 1,700,000 pounds of dynamite passed over the highways of that county in a single year. During the first three and a half months of 1932, Lieut. Newman reports 2,000 sticks of dynamite were stolen in the metropolitan district outside of New York City proper.

A cigar-box bomb sent to Judge Otto Rosalsky on March 17, 1912, gave the late Owen Eagan, famous New York bomb sleuth, his only serious injury in twenty-one years of continuous service. Eagan was opening this box, made by the insane bomber Henry Klotz—who later killed two women and then blew himself to death with a bomb of his own construction—when it exploded. He lost the fingers of his right hand.

One of the most picturesque characters among detectives in this line of work, Eagan is said to have handled in the neighborhood of 7,000 bombs during his service with the Bureau of Combustibles in New York City. To protect himself from reprisals by the underworld, he kept his whereabouts a constant secret. His name appeared in no telephone book or city directory. He had no mailbox under his own name and he moved at frequent intervals. In the end, acute indigestion, not high explosives, caused his death.

Other bomb experts take similar precautions. The name of one of the country's foremost authorities, a Federal man, has virtually never appeared in the newspapers. He maintains a secret laboratory in a desolate spot about thirty miles from New York City. There, he works behind steel barricades and in sand pits. *(Continued on page 111)*

HOW SLEUTHS TRAP BOMB MURDERERS

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At this lonely laboratory, a vise, clamped to a stump in an open space, plays an important part in the dangerous task of removing the end caps from pipe bombs in order to take out the explosive. If even a particle of dynamite has worked its way into the threads on the pipe, the jar of unscrewing the metal cap is likely to detonate the whole bomb. Not long ago, a professional bomb-maker was killed instantly in this way when he tried to remove the cap from one end of a bomb he had made.

After the pipe is secured in the vise attached to the stump, the expert explained, he attaches a Stillson wrench to the end cap and then ties a seventy-five-foot rope to a ring at the end of the wrench handle. Then, while lying in a sand pit, he tugs on the rope until he has pulled the wrench as far as he can. With the rope in his hand, he then crawls cautiously to another sand pit on the opposite side of the bomb and pulls the wrench around the other half of its circle. Until the cap is off, he keeps hidden whenever it is moved, even a fraction of an inch. This menace of particles being caught in the threads makes "loving cups," he told me, one of the most dangerous bombs to deal with.

During the Wilson administration, this expert set what still stands as a record. He opened ten deadly bombs in a single day. Counterfeiting the label of a New York department store, a crank had sent bombs disguised as perfume to Cabinet members, Senators, and prominent financiers. They were among the most cunningly contrived murder packets in all bomb history.

Inside a wooden cylinder was a square perfume bottle filled with acid. The neck of the bottle was attached to the top of the wooden cylinder by an iron collar so when the top was turned the bottle broke and the acid touched off the bomb. Discovery of the plot and the broadcasting of a quick alarm saved the lives of the intended victims. In opening the containers, the expert split the wooden cylinders without disturbing the tops.

Once, a murderer escaped arrest by riding on crowded subways for two whole days. Instead of hiding, he did the unexpected and police were taken off their guard. Similarly, the first rule of the bomb squad is: Never do what the bomb-maker expects you to do. For instance, if a suspicious package is wrapped in paper and tied with a string, the detective does not cut the string or unwrap the box. He tears a hole through the paper on one side and leaves the string intact. If the box has a lid, he never lifts it. Instead, he takes out an end or the bottom to get inside. If the container has a top that slides off telescope fashion, or screws off, he leaves it strictly alone and gains entrance some other way.

THROWN bombs, with detonating studs projecting out on all sides so the explosion takes place the instant it strikes, are rarely used in the United States. The largest bomb ever found intact in the United States was a "loving cup" five feet long and twenty-two inches in diameter. The smallest bomb was the exact size and shape of a cigar. Chemicals within it acted upon each other to bring about an explosion and incendiary fire in the hold of a ship.

The last bomb Owen Eagan opened was an innocent-looking violin case that held fifteen pounds of dynamite. It was found on the back stairway of a newspaper plant in New York. Each year, criminal dynamiters devise new methods of carrying out their sinister designs. Books, saturated with nitroglycerin, have been used in some cases. Bombs, attached to the starter and chassis, have hurled victims through the tops of automobiles when they stepped on the starter buttons.

Sometimes, bombs are hermetically sealed and have to be opened by rifle bullets. This is the safest way for an inexperienced person to handle an infernal machine. But it is unsatisfactory from the experts' point of view because the bomb explodes and destroys most of the evidence it may contain.

After the Easton tragedy there was an epidemic of bomb scares in various parts of the country. A suspected package was taken from a Connecticut post office and fired at half a dozen times. As nothing happened, the bundle was opened. It contained the skins of eight muskrats and one skunk!

In Washington, D. C., a heavy wooden box, addressed to Dr. Julius Klein, Assistant Secretary of Commerce, aroused suspicion. Marines at the Naval Research Laboratory fired rifle bullets into the box and experts, working with mirrors and long implements behind steel shields, pried off the lid. Inside were small white tablets, a new form of concentrated heat which an inventor had sent in for an opinion as to its marketability.

EVEN when a bomb explodes, the detective who visits the scene of the blast can still obtain vital information. The color of the smoke as reported by spectators will indicate the kind of explosive used. Dynamite smoke, for instance, is white; T.N.T., dark brown; black powder, bluish white.

In addition, the effect of the blast tells its story. Powder pushes; dynamite shatters. A gas explosion has no central point of greatest damage. It can be told from a powder blast by the fact that the powder usually blows a hole under itself as well as pushing outward.

The purpose behind most bombings, I was told, is to kill a supposed "tyrant," or to get revenge. Practically all of the wholesale "murder by mail" plots, in which infernal machines are posted, are the result of old-world political feuds that have been carried to this country. Contrary to general opinion, only a few bomb-plotters have been insane. Most of them are moved by political beliefs or a desire for personal vengeance.

Early in the morning, two weeks before Christmas in 1929, a terrific explosion in front of a Brooklyn, N. Y., tombstone-maker's home brought neighbors pouring into the street. A mushroom-shaped cloud of white smoke was rising slowly above the house. The blast had demolished the porch, shattered the front rooms of the house and killed three children sleeping in them.

Dynamite, packed in a black bag and touched off with a time mechanism, had been planted by the son of another tombstone maker as an act of revenge because the intended victim had refused to form a partnership with his father. Detectives, starting with clues found in the debris, tracked down the murderer, who was sentenced to a long prison term.

In this case, as in practically all bombings, the intended victim escaped and innocent persons died. An expert who has dealt with bombs for more than twenty years said that he has never known an important bombing that succeeded in killing the person against whom the plot was hatched.

In the Easton case, two mail clerks and an explosive plant employee were killed. In the plot in which bombs were sent to the Wilson Cabinet members, the only person hurt was a maid who opened packages in the home of a southern Senator. In the Wall Street blast, thirty-three people were killed and 100 were injured. But they were all clerks, errand boys, brokerage employees.

Thrilling Air Battles Fought for Movies

(Continued from page 28)

to the hawklike dives was a fixed camera. It pointed straight ahead, and as the attacking plane swept in from the left front, missing the lower ship some ten feet, the camera filled the screen with views of an onrushing plane that seemed to fasten its wheels in the wings as it tore overhead. Then, by undercranking and omitting alternate frames in printing the negative, and by blending the pictures with the actor's face, it gave every appearance of rushing in from the rear and away over the pilot's head—by inches.

"By mounting the camera on the center section," Captain Robinson explained, "we can photograph ahead without taking in part of our own plane. This eliminates blind spots, blanked off by the wings when the camera is located in a cockpit or alongside the fuselage. With the camera on top, the pilot maneuvers the plane, framing the picture between the struts, upper wing and fuselage, and shoots the picture exactly as he sees it. This is an especially valuable arrangement for filming barrel rolls, dog-fights, and spins. It teaches a picture pilot the necessity of keeping his ship 'on the spot,' for the camera angle in close quarters is limited."

MANY air thrills combine camera tricks, use of dummies, and unusual skill on the part of pilots. One script called for a small boy, through accident, to be carried into the air sitting on the running gear of a large transport plane, to be rescued in mid-air by a pilot who climbed out of his cockpit onto the upper wing. Meantime the lower ship flew with no one at the controls, until it fell away, leaving the pilot hanging on to the boy.

The air supervisor rigged a dummy boy under the big plane, connecting the dummy with a bomb release, such as the big Army bombardment planes carry to cut loose their high explosives, which led to a mechanic hidden in the cabin above. A stunt pilot took off in the pursuing plane and after overtaking the larger ship crawled out of his cockpit, out on the wing and, as the two ships bounced perilously near each other, reached for the dummy boy. Meantime, as the cameras ground out a long shot, a hidden pilot, bent low in the second cockpit, flew the lower plane.

So much for that part of the rescue. Next day, for close-ups, the dummy boy took off in the same position, this time with another dummy grasping his legs. The second dummy was a counterpart of the rescuing pilot. To duplicate the preceding day's scene, but much closer up, the same plane, apparently pilotless, flew in under the tri-motor and for a mile the hidden pilot kept his upper wing barely touching the dummy's feet. It appeared exactly as though it were standing on the lower plane.

Then, at the proper moment for the supreme thrill, the mechanic above tripped the bomb release, the dummies fell, the parachute, delayed in opening by a long rip cord, opened and both floated easily to earth.

The following morning Captain Robinson reported for the day's work.

"How'd the dummies look?" he asked the director.

"Too much like dummies," he was told. "Liven 'em up a bit. Make 'em more human. We'll shoot the scene again this afternoon."

Not even dummies can act naturally in the talkies, it seems!

Later in the day more footage was ground out, and the rescue completed.

A director wanted the late Leo Nomis, who perished in his stunting plane a few weeks later when it spun into the ground from a high altitude, to crash through the roof of a building. After some consideration he decided the stunt was too dangerous, not from the impact but from the fire that was sure to follow, and gathered with Nomis, the technical director, and the doctor around a blackboard to plan the crash.

"Leo," said the director, "your plane will come down out of control. You land here," indicating a spot in front of the building, "and the ship hurtles through the wall. The fire truck will be offstage. Got it?"

"Okey," Leo replied. A few minutes later, after having climbed the little biplane 2,000 feet above the set, he stuck her nose down. As the cameras ground out footage, wires screamed an accompaniment to the rocketing plane as he crashed with a roar heard for miles roundabout—not in the street, but square on the roof of the building. The thrill supreme!

Next day the same director asked Nomis to dive a second plane 1,500 feet down over a machine gun nest, firing blank cartridges between the blades of his spinning prop in a sensational and successful picture effort to wipe out the crew. The stunt flyer swept down through the low-hanging cloud, opened fire on the gun, and pulled back on the stick a short distance above the gun. But he had misjudged his speed and altitude and in a few seconds had squashed so low that the elevator on the tail of his plane struck the gun. For fully fifteen minutes Nomis flew overhead, trying vainly to learn what had happened to his controls. It was only after he had pancaked his plane in the near-by field, washing out the landing gear, that he found he had ripped off the flipper and had no vertical control over his machine.

Whether the script calls for a thrilling dog-fight, high above the clouds, or a sudden crash on terra firma or in the sea, every detail is diagrammed before a plane leaves the ground. Before Dick Grace spun two planes from a mile above into the green waters of the Pacific a few weeks ago for a brief flash on the screen, he and his co-workers had planned every maneuver of the stunting and camera planes, even to the fast spin and tight spiral as the camera followed the doomed plane and daring pilot to their watery rendezvous.

Elmer Dyer, who in twelve years of filming screen plays has put in the can celluloid records of twelve air thrillers, followed Grace down on those two quick plunges to possible death, the first high altitude movie crashes ever attempted with the sea on the receiving end. Six rescue boats and a flock of cameras were ready below as the camera ship circled a mile overhead waiting for Grace. Not a foot of film was ground until Grace, Dyer, Dyer's pilot, and the director had conducted a long skull practice before a blackboard.

"We drew a picture of the coast line," Dyer explained. "The indentation was the cove on the Malibu just south of the movie beach colony. In the background were the mountains, east of Los Angeles. I figured we could spiral around Dick as he spun down, keeping his ship on the inside of the circle and showing flashes of mountains and water as we went down.

"'We'll circle to the right over the cove,' I said to Dick. 'You come in from the northeast. When we waggle our wings, you kick her into a spin, and we'll spiral down after you.'

"We circled the cove six times waiting for Dick to fly into position. Then I saw him flying in from the proper direction. I started the camera and touched my pilot on the shoulder. He waggled his wings and without further warning I was thrown against the side of the cockpit as I saw Dick's ship tilt up on one side and begin spinning. My pilot continued his tight spiral, necessary to keep the camera on an even keel and pointed directly at the spinning ship. We stayed on his tail all the way down and I could almost feel the sting of salt spray kicked into the air by the impact."

In filming such scenes, when object and camera ships drop at 200 miles an hour, the camera and its mount must be part of the ship. Air pressures build up so rapidly as speed increases that the old style of fastening the cameras with webbing belts would not hold them. The present form of mount is of tubular steel construction, bolted into the main members of the fuselage.

Not all the thrills are in the air, however. One sequence filmed not long ago showed a plane rolling around the sky, then suddenly skimming in under a telephone line and plunging into a hay pile. Three planes took part in these brief scenes, the first a fast biplane with powerful engine capable of pulling the ship out of trouble near the ground. A stunt pilot flew the ship through the queer maneuvers, under the telephone wires, and directly above the hay pile. His flight was "cut" on the film just before he reached the point of his supposed crash.

A second plane, worn out by its many movie maneuvers, was planted on its nose in the hay, its wings torn and broken for realism. Here the close-ups of the actors were filmed.

THE actual crash had not yet been filmed. Since the plane must be crashed and left standing in exactly the same position as the planted ship the air director did not care to risk a pilot's life in a vertical dive. A long elevated runway and a tripping device came to the rescue. A hundred feet the plane roared along the scaffolding and at the end a tripping device permitted a powerful shock cord to pull the stick quickly forward. The plane nosed over and dropped thirty feet straight down into the hay. A camera near by recorded the short dive. Later this was matched with the scene of the actual flight, the two dovetailing into a perfect sequence.

In many instances, the thrill-makers have learned, they can crack an airplane more realistically, and with infinitely less danger, by mechanical means than by having a pilot stunt it into the earth. Dynamite that hurls parts of the plane high into the air supplies the sensation of the crash.

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